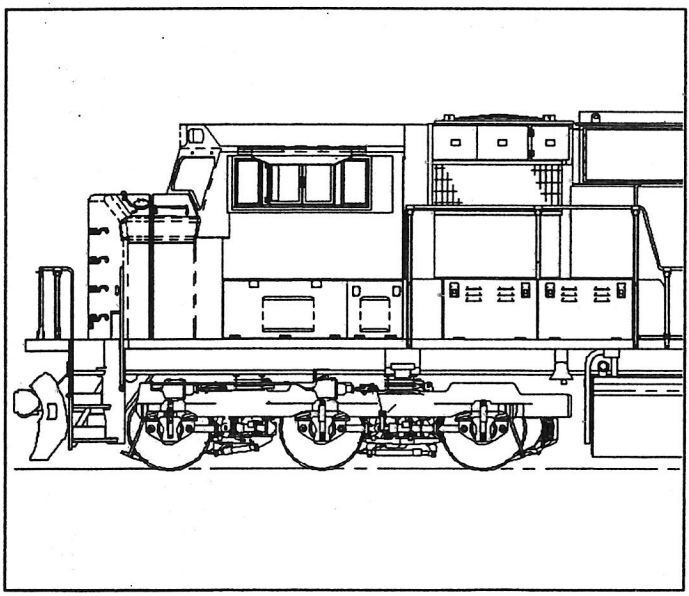
SD75I

Operator's Manual



Canadian National Railways

Locomotive Nos. 5626 thru 5730

ELECTRO-MOTIVE
General Motors Corporation

Electro-Motive SD75I

LOCOMOTIVE OPERATOR'S MANUAL

Canadian National Railways (CN North America)

Units 5626 thru 5730

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FOREWORD

GENERAL

The purpose of this manual is to act as a guide in the operation of the locomotive and its equipment. The information was compiled for a typical SD75I locomotive with basic equipment and requested extras. The equipment selected for coverage was chosen as representative and not intended as an indication of availability or use on any one particular unit of an order. When special extra equipment is involved, consult specific drawings or instructions as provided by the railroad.

Information contained in this manual is based on data available when released for printing. Some changes in locomotive equipment or computer programming may occur after publication of this manual.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the user's purposes, the matter should be referred to the Electro-Motive Division (EMD).

INTRODUCTION

This manual is intended as a guide for operating EMD Model SD75I locomotives. These locomotives are equipped with a computer-based control system that incorporates routines for EMD's Super Series controlled wheel creep/anti-wheelslip operation. A computer display panel, in the cab, annunciates various aspects of locomotive operation to the crew, and enables diagnostic testing of locomotive systems by maintenance personnel.

Locomotive description and operating instructions are divided into four sections as follows:

Section 1. "General Information"

Provides general SD75I data and principal equipment descriptions.

Section 2. "Controls and Indicating Devices"

Explains functions of controls used to start and operate the locomotive, and indicating devices to monitor various locomotive systems.

Section 3. "Operation"

Outlines procedures for locomotive operation.

Section 4. "Troubleshooting"

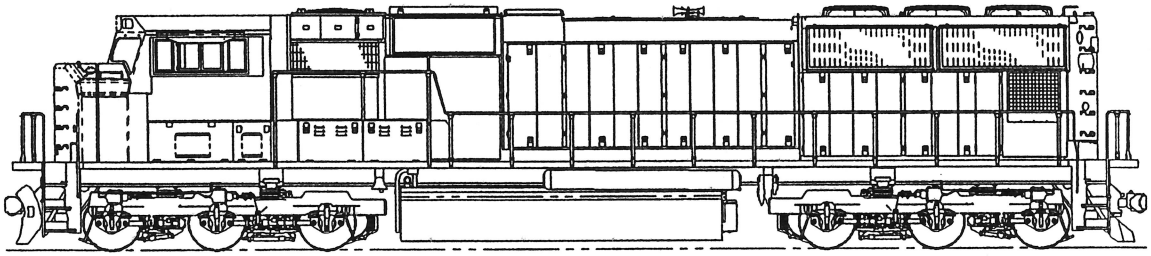
How to use computer Display Diagnostic System (DDS). Explanation of messages from computer and indicator lights, as well as the EMD electronic Diesel Engine Control System (EMDEC) diagnostics.

To be of the most benefit to the reader, these sections should be read completely in the sequence in which they appear. Information concerning equipment maintenance, adjustment, and testing is contained in other EMD publications pertaining to this model.

SPECIAL NOTICE:

In general; the term "Operator" as used herein, associated with a location or control, relates to the crew member principally responsible for the operation of the locomotive. - **Railroads may designate this crew member as the "Engineer" or "Driver."**

The term "Helper," as used in association with a location or control, relates to a support crew member (or members). - **Railroads may designate this crew member (or members) as the "Conductor," "Brakeman," "Fireman," "Assistant," "Observer," "Inspector" or "Helper" - or combinations thereof.**



TYPICAL SD751 LOCOMOTIVE

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Section 1. General Information

INTRODUCTION

This section of the manual has the following major divisions:

- **"LOCOMOTIVE GENERAL DATA"**
  Page 1-2:
  Locomotive specifications.

- **Figures 1-1 & 1-2**
  Pages 1-6 & 1-7:
  Illustrate locations of key equipment on the locomotive.

- **"LOCOMOTIVE GENERAL DESCRIPTION"**
  Starting on page 1-8:
  General information, introducing "LOCOMOTIVE OPERATION."

- **"LOCOMOTIVE OPERATION"**
  Starting on page 1-8:
  A brief description of locomotive operation.

LOCOMOTIVE GENERAL DATA

Locomotive Model Designation ..... **.SD75I**
Locomotive Type ..... **(C-C) 0660**
Locomotive Power (Nominal)..... **.4300 HP**

POWER PLANT

Engine Type..... .Turbocharged Two-stroke Diesel
Model 16-710G3B
Number of Cylinders..... .16
Full Speed ..... 950 RPM
Idle Speed, Normal ..... 269 RPM
Idle Speed, Low..... 200 RPM

ELECTRICAL SYSTEM

MODEL AR20ABE-CA7B MAIN GENERATOR

AR20 Traction Alternator Rectified Output :
Maximum Potential..... 1465 VDC
Max. Continuous Current ..... .8100 A

CA7B Companion Alternator Output:
Nominal Potential ..... 200 VAC

AC AUXILIARY GENERATOR

Model A8589
Rectified Potential..... 74 VDC
Maximum Power Output..... 18 kW

TRACTION MOTORS

Model D90TR
Number 6
Type..... .DC, Series-Wound, Axle-Hung, Tapered Roller Support Bearings, Forced Air Ventilated

LOCOMOTIVE BATTERIES

Model 8-CH-33P
Number 8
Number of Cells (Each) 4
Potential (Each Battery) ..... 32 VDC
Rating (8 Hour) ..... 660 Amp. Hr.

AIR SYSTEM/ EQUIPMENT

AIR BRAKE SYSTEM

Type 26LUM

AIR COMPRESSOR

Model ..... WLA
Type 2-Stage
Number of Cylinders 4
Displacement @ 900 RPM ..... 254 Cu. Ft./ Min.
Cooling Medium ..... Engine Coolant
Lube Oil Capacity (20 Wt.) ..... 17.5 U.S. Gal.

SPEED LIMITATION

Limits are based on original equipment, consisting of:

- 83:18 gear ratio
- 42" diameter wheels.

Maximum Speed (computer limited) ..... 70 MPH
Minimum Continuous Speed ..... 11.4 MPH
@ 109,150 Lbs. T.E.

Note: To protect traction motors, computer may reduce tractive effort to "Minimum Continuous" level during extended motoring episodes that are slower than 11.4 MPH.

SUPPLIES/ CAPACITIES

LUBE OIL SYSTEM

Capacity..... 436 U.S. Gal.

COOLING SYSTEM

Capacity..... 270 U.S. Gal.

SANDING SYSTEM

Capacity.....40 Cu. Ft. (20 Cu. Ft./ End)

FUEL CAPACITY

Fuel Tank.....3600 Imp. Gal.
Retention Tank †.....100 Imp. Gal.

† Retention tank mounts within fuel tank, and reduces fuel tank capacity by approximately 100 Imp. gallons. (Retention tank capacity is 100 Imp. gallons.)

MAJOR DIMENSIONS/ WEIGHTS, NOMINAL

HEIGHT (HTCR TRUCKS)

Over Cooling Fan Guards .....15' 7.60"
Over Dynamic Brake Fan Guard.....15' 7.19"
Over Dust Bin Blower Hatch .....15' 7.71"
Over Air Horn.....15' 11.16"

WIDTH

Over Underframe.....10' 0.75"
Over Handrail Supports.....10' 3.44"
Over Wind Deflectors .....11' 1.62"

LENGTH

Over Coupler Pulling Faces . . . . . 72' 4.00"

WEIGHT

Typically Equipped . . . . . 385,000 lbs.
Weight on Drivers 100%

SD75I MINIMUM CURVE NEGOTIATION

Following data is based on original equipment "E" type couplers.

Single Unit:
206 Ft. Radius - 27.8° Curve

Single Unit Coupled to 50 Ft. Box Car:
336 Ft. Radius - 17.0° Curve

Two Units, Coupled:
231 Ft. Radius - 24.8° Curve

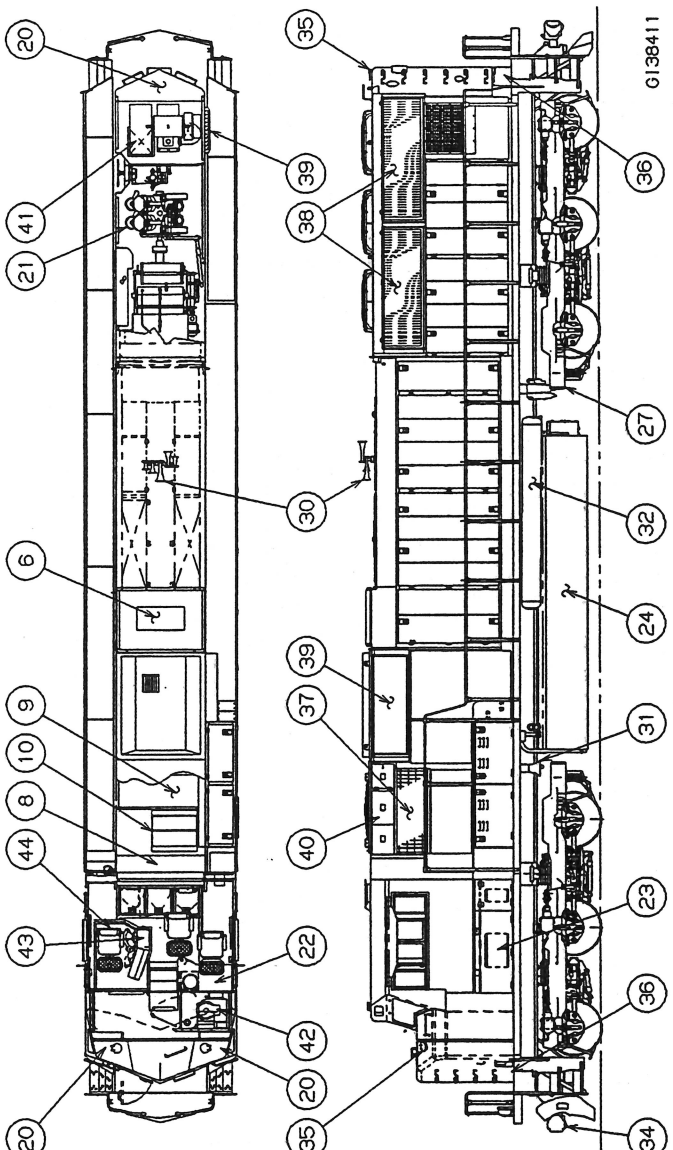
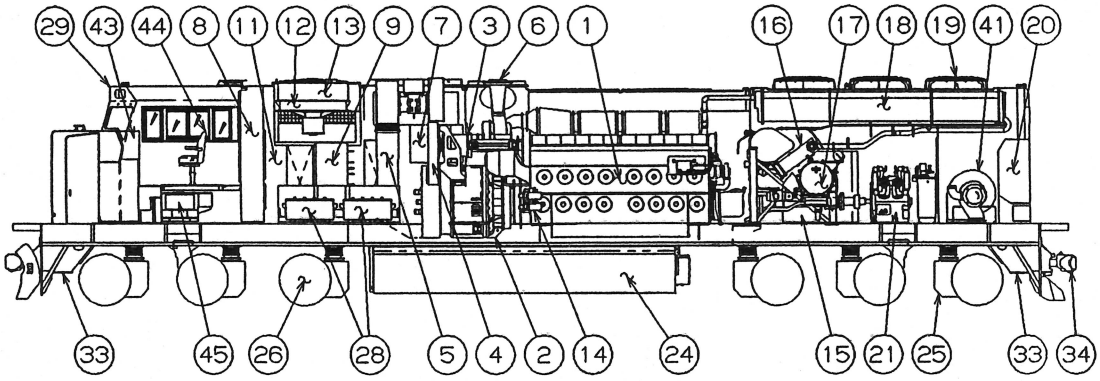


Figure 1-1. Typical SD75I General Arrangement



1- ENGINE
2- MAIN GENERATOR/ALTERNATOR
3- AUXILIARY GENERATOR
4- GENERATOR/ALTERNATOR BLOWER
5- #1 TRACTION MOTOR BLOWER & DUCT
6- ENGINE EXHAUST SILENCER
7- ENGINE AIR FILTERS
8- #1 ELECTRICAL CONTROL CABINET
9- #2 ELECTRICAL CONTROL CABINET
10- ELECTRICAL CONTROL CABINET FILTERS
11- DYNAMIC BRAKE COMPARTMENT
12- DYNAMIC BRAKE FAN
13- DYNAMIC BRAKE GRIDS
14- STARTING MOTORS
15- ACCESSORY RACK
16- LUBE OIL COOLER
17- LUBE OIL FILTER
18- ENGINE RADIATORS
19- COOLING FANS
20- SANDBOX
21- AIR COMPRESSOR
22- HELPER'S DESK
23- AIR BRAKE EQUIPMENT
24- FUEL TANK
25- TRACTION MOTORS
26- WHEELS
27- TRUCK
28- BATTERIES
29- HEADLIGHT
30- HORN
31- BELL
32- MAIN AIR RESERVOIRS
33- DRAFT GEAR
34- COUPLER
35- SAND FILLER
36- SAND TRAP ACCESS
37- DYNAMIC BRAKE AIR INLET
38- COOLING AIR INLET W/SHUTTERS
39- INERTIAL FILTER INLET
40- 'D' CONTRACTORS ACCESS
41- #2 TRACTION MOTOR BLOWER
42- TOILET COMPARTMENT
43- CONTROL STAND
44- CAB SEAT
45- CAB HEATER

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Figure 1-2. Typical SD75I General Arrangement

LOCOMOTIVE GENERAL DESCRIPTION

The General Motors Model SD75I diesel-electric locomotive, Figure 1-1, page 1-6, is equipped with a turbocharged 16 cylinder diesel engine which drives the main generator. Electrical power from the main generator is distributed to the traction motors through the No. 2 electrical control cabinet. Each of the six traction motors is geared directly to a pair of driving wheels. Traction motor-to-wheel gear ratio and wheel diameter together determine maximum permissible locomotive operating speed.

The basic locomotive is arranged and equipped so that the short hood or cab end is considered the front or forward part of the unit. However, the locomotive operates equally well in either direction. On this order of locomotives, the Operator's Control Stand is positioned to provide improved visibility when the unit is operated with the long hood forward.

While each SD75I locomotive is an independent power source, a number of units may be combined in a multiple-unit consist to increase load capacity. For multiple-unit operation, the operating controls on each unit are jumpered or "trainlined" to adjacent units to allow all locomotives in the consist to be simultaneously controlled from the lead unit.

LOCOMOTIVE OPERATION

Storage batteries provide the energy required to start the diesel engine. The engine start switch controls battery power to two starting motor solenoids mounted at the lower rear right hand side of the engine. These electrical solenoids engage the starting motor pinions with the engine ring gear. When both pinions are engaged, battery power is applied to the starting motors to crank the diesel engine.

The diesel engine is primed with fuel prior to starting. To do this, the operator places the engine start switch in the FUEL PRIME position. This applies battery power to the fuel pump circuit, running the pump, which pressurizes the Electronic Unit Injection (EUI) system with fuel. The fuel pump moves the fuel from the fuel tank under the locomotive to the injectors. After the entire system has been supplied fuel, the cylinders will fire when the engine is cranked. With the engine running, the fuel pump motor circuit is supplied directly by the auxiliary generator.

The diesel engine is the source of locomotive power. When the engine is running, it directly drives three electrical generators and their associated cooling fans, and the water and lube oil pumps (and, as initially provided, a multi-cylinder air compressor). The engine-driven components in the locomotive system convert the engine mechanical power to other forms to perform their individual functions:

1. The main generator rotates at engine speed, generating alternating current AC power. The AC power is then converted to direct current DC power by rectifier banks within the generator assembly. Switchgear and contactors apply the DC power to the traction motor circuits.
2. The companion alternator is physically coupled to the main generator. It supplies current to excite the main generator field, and to power the radiator cooling fans, the traction motor and inertial filter blower motors, and various transductors and control devices.

3. The auxiliary generator is driven by the engine gear train at three times engine speed, generating AC power. Power from the auxiliary generator is supplied to an external 3-phase full-wave rectifier in a battery charging assembly. There it is converted to 74 volt DC power for companion alternator excitation, control system operation, and to charge the locomotive batteries. The auxiliary generator also supplies 74 volt DC operating power for the engine fuel and turbocharger lube oil pump circuits, cab heating and air conditioning, locomotive lighting and other miscellaneous equipment. A large blower assembly is directly coupled to the auxiliary generator to provide cooling air to the main generator and companion alternator.
4. As initially provided, an air compressor drive shaft is directly coupled to the diesel engine crankshaft. The compressor pressurizes the main air reservoirs which supply air to operate the locomotive and train brakes, as well as other pneumatic devices such as sanders, windshield wipers, shutter operating cylinders and horn.
5. The engine gear train drives two centrifugal water pumps which circulate coolant through the engine and cooling system.
6. The lube oil pumps are also connected in the engine gear train. They supply lubricating oil to critical operating surfaces throughout the engine.

The main generator supplies electrical energy to the No. 2 electrical control (power switchgear) cabinet, which is located in the dynamic brake compartment. Power contactors and switchgear in the No. 2 cabinet control power distribution to the traction motors. The locomotive computer, located in the No. 1 electrical control cabinet, controls the No. 2 cabinet devices. Operator control settings, computer operating routines, and operating conditions together determine how the computer controls the No. 2 devices.

A major part of locomotive control system operation involves the interrelated functions of the throttle, engine speed (governor) control, and load (regulator) control. These functions are performed using the electronic interface circuitry of the Electro-Motive Diesel Engine Control System (EMDEC).

- The throttle handle position (engine speed reference) is a Digital to Analog circuit using integral voltage ramping. This throttle position reference is used by the EMDEC system to control the *amount* of fuel supplied to the cylinders.
- The engine "governor" function holds the engine speed at a constant RPM as set by the throttle position.
- Changing operating conditions create change in the diesel engine loading level. When the engine load changes or engine output power level changes, engine speed will change. The EMDEC load regulator function, which is a discrete simulated circuit in the interface, acts to balance the engine speed setting (referenced from the throttle position) with the engine power level determined by the load.
- The EMDEC system communicates the amount of fuel being consumed through a one way digital link to the locomotive EM2000 computer. The EM2000 determines if the engine is operating properly and can cut back on the load in order to maintain engine speed.
- As the operator advances the throttle handle, the electrical control system causes more current to flow through the field of the main generator. This increased excitation current results in an increase in power to the traction motors. Thus the locomotive power, as well as engine speed, increases progressively in throttle steps.

Most control and protective functions are programmed into the locomotive EM2000 computer. The EM2000 monitors critical functions in the locomotive power system and provides a display message if a fault occurs. For serious faults, the computer also sounds the alarm and takes corrective action.

Section 2.
Controls and Indicating Devices

INTRODUCTION

This section briefly describes controls and indicating devices used by the locomotive operator. Descriptions of certain other equipment, not required for normal operation, is also included in this section for reference.

Most of the controls and indicating devices used by the operator are located in the locomotive cab. Engine starting and monitoring equipment is located in the engineroom.

This section of the manual has the following divisions:

Locomotive Operating/Indicating Device Areas, page 2-2:

Figure 2-1 locates groups of controls and indicators on the locomotive.

Cab Equipment, page 2-3:

- Operator's Control Stand
- Overhead Control Console
- No. 1 Electrical Control Cabinet

Engineroom Equipment, page 2-65:

- Engine Starting Controls
- Monitoring Devices
- Miscellaneous Engineroom Devices

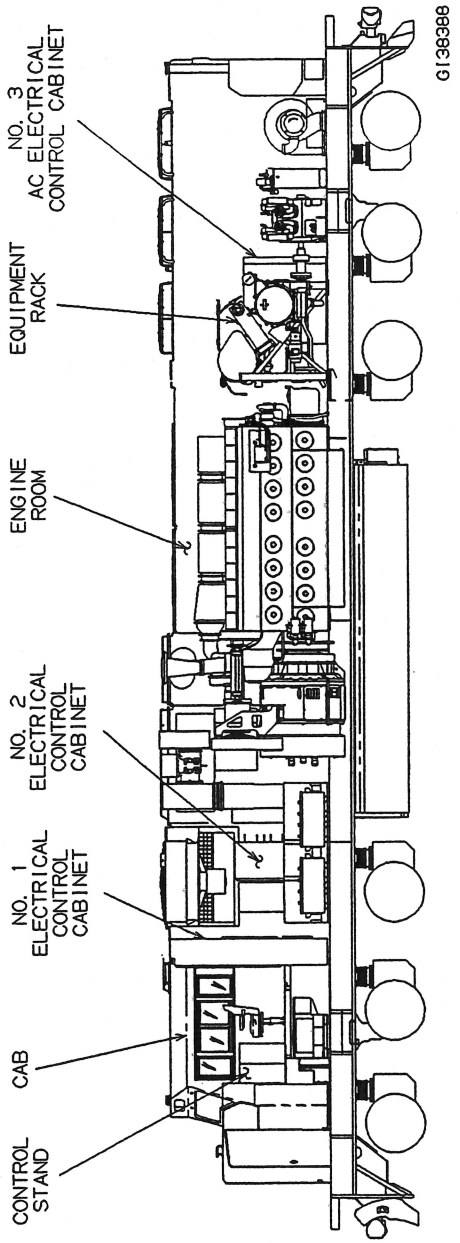


Figure 2-1. Locomotive Operating/Indicating Device Areas

CAB EQUIPMENT

Operating equipment is located in the cab at the following locations

- Operator's Control Stand - page 2-4.
- Overhead Control Console - page 2-33.
- No. 1 Electrical Control Cabinet - page 2-45.

OPERATOR'S CONTROL STAND

Controls that must be within the operator's reach, or indicators that the operator must be able to see at a glance, are located on the Control Stand, Figure 2-2. , on page 2-4. The main controls - those for throttle, brakes, and direction - are located immediately beside or in front of the operator. Various other devices are located nearby.

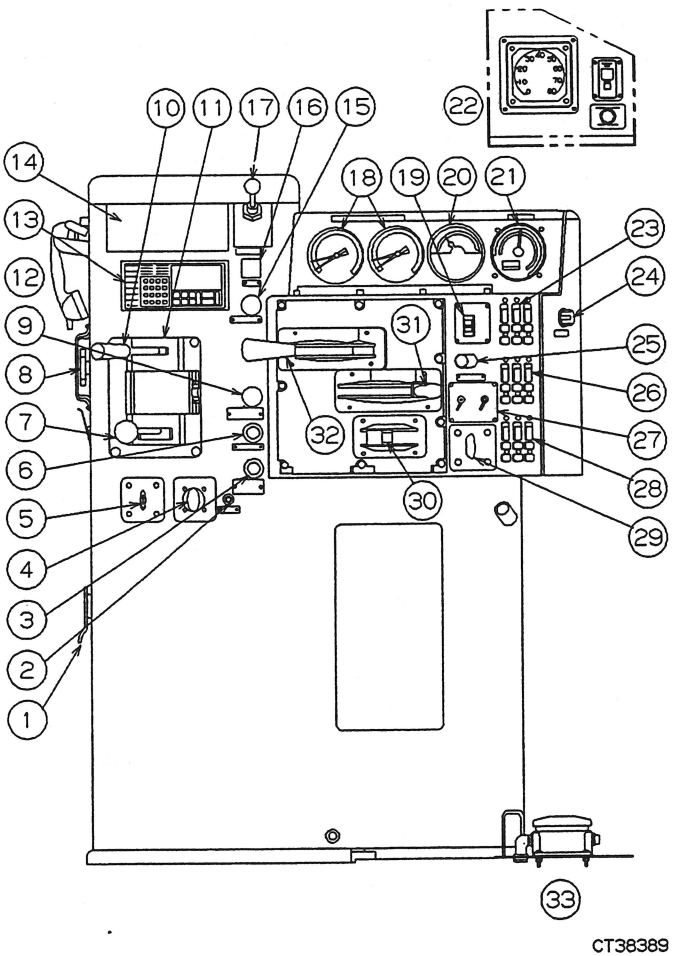


Figure 2-2. Operator's Control Stand.

1. Multiple Unit (MU-2A) Valve
2. Attendant Call Push-Button Switch
3. Lead Truck Sand Push-Button Switch
4. Heating & Ventilation Rotary Control Switch
5. Headlights Rotary Control Switch (Rear)
6. Manual Sand Push-Button Switch
7. Independent Brake Valve Handle
8. Trainline Air Pressure Adjustment Valve
9. Train Monitoring System (TMS) "Reset" Push-Button Switch
10. Automatic Brake Valve Handle
11. Cut-Off Pilot Valve
12. Radio Handset & Cradle
13. Radio Transceiver Control Unit
14. Trainline Information & Braking System (TIBS) Input Display Unit (IDU)
15. Air Horn Sequencer Control Push-Button Switch
16. Bell Ringer Control Push-Button Switch
17. Air Horn Control "Joy Stick" Switch
18. Duplex Air Pressure Gauges
19. Slow Speed Control "Rocker" Switch
20. Air Flow/Minute Indicator
21. Load Current Indicating Meter (Ammeter)
22. Speed Indicator/Events Recorder, Alarm Display & Dimmer Rheostat
23. Control & Operating Slide Switches
24. Gauge Lights Dimmer Rheostat
25. Alarm Silencer Push-Button Switch
26. Gauge, Platform & Number Lights Slide Switches
27. Ditch Lights Toggle Switches
28. Ground & Step Lights Slide Switches
29. Headlights Rotary Control Switch (Front)
30. Directional (Reverser) Handle
31. Throttle Handle
32. Dynamic Brake Handle
33. Train Monitoring System (TMS) "Reset" Foot Switch

LOCOMOTIVE CONTROLLER

The locomotive controller, Figure 2-3, is a panel assembly located on the upper front portion of the operator's control stand. This assembly has three operating handles which are described in the following paragraphs:

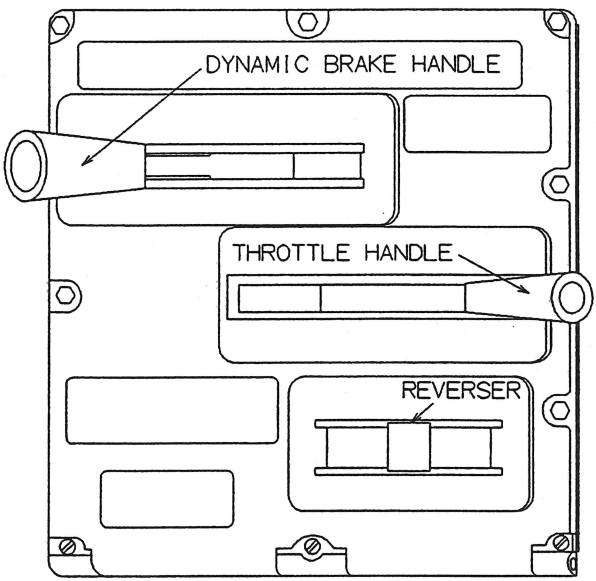


Figure 2-3. Locomotive Controller.

DYNAMIC BRAKE Handle

A separate handle is provided for control of the dynamic brake responses, Figure 2-4, page 2-7. It is the uppermost handle on the controller panel and is moved from left to right to increase braking effort. The handle grip is somewhat out-of-round with the flattened surfaces vertical to distinguish it from the throttle handle, which has its flattened surfaces horizontal. This brake handle has two detent positions; **OFF** and **SET UP**, and an operating

range of from 1 through **FULL** 8, through which the handle moves freely without notching. Mechanical interlocking prevents the dynamic brake handle from being moved out of the **OFF** position unless the throttle is in **IDLE** and the directional (reverser) handle is positioned for either *forward* or *reverse* operation.

CAUTION

During transfer from power operation to dynamic brake, hold throttle handle in **IDLE** for ten (10) seconds before moving dynamic brake handle to **SET UP** position. This eliminates the possibility of a sudden surge of braking effort with possible train run-in or motor flash-over.

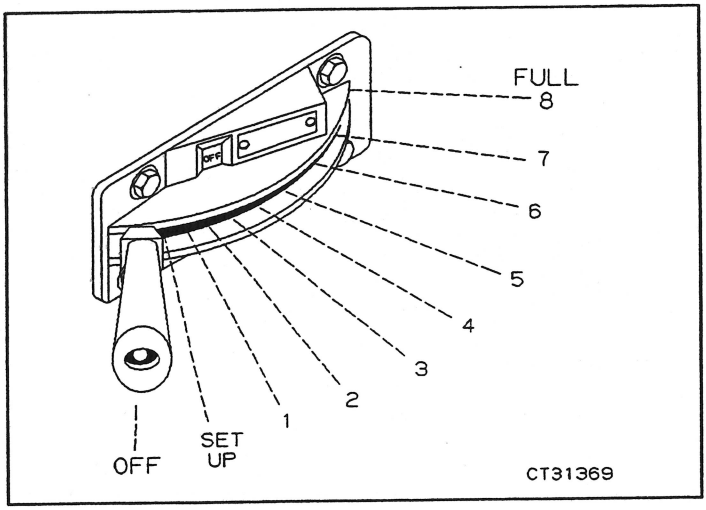


Figure 2-4. Dynamic Brake Handle

THROTTLE Handle

The throttle handle, Figure 2-5, page 2-8, is the middle handle on the controller panel, located just below the dynamic brake handle. It is moved from right to left to increase locomotive power.

The handle grip is somewhat out-of-round with the flattened surfaces horizontal to distinguish it from the dynamic brake handle. The throttle has nine detent positions (notches); **IDLE**, and 1 through 8 plus a **STOP** position, which is obtained by pulling the handle outward and moving it to the right beyond **IDLE** to stop all engines in a locomotive consist.

Mechanical interlocking prevents the throttle handle from being moved out of **IDLE** into power positions when the dynamic brake handle is advanced to **SET UP** or beyond, but it can be moved into **STOP** position to stop all engines in the consist. The throttle cannot be moved when the directional (reverser) handle is centered and removed from the controller.

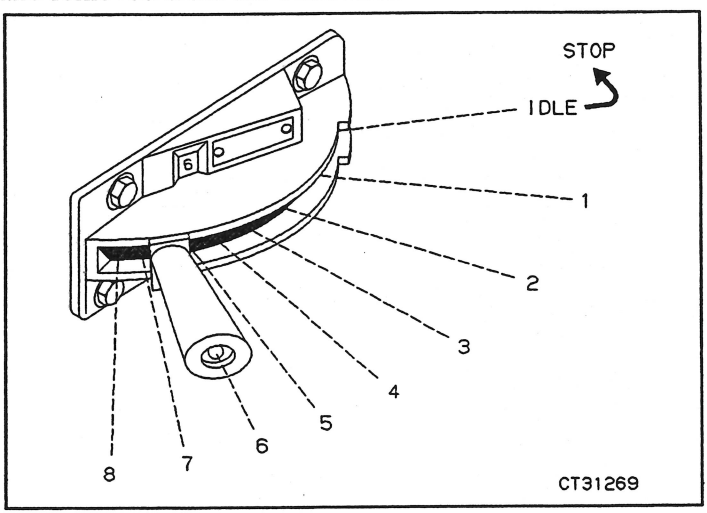


Figure 2-5. Throttle Handle

DIRECTIONAL (REVERSER) Handle

CAUTION

Damage to the traction motors may occur if the directional (Reverser) handle is moved frequently (routinely) from *forward to reverse* or from *reverse to forward* while the locomotive is in motion - below a speed of 8 mph. Therefore, the handle position should be changed only when the locomotive is completely stopped. This locomotive is equipped with a system modification which will prevent reversal above 8 mph in order to prevent "plugging" of the traction motors.

The Directional (Reverser) handle, Figure 2-6. , on page 2-10, is the lower handle on the controller panel. It has three detent positions; **LEFT**, **NEUTRAL** (centered), and **RIGHT**. When the handle is moved to the **RIGHT** toward the short hood end of the unit, circuits are set up for the locomotive to move in that direction. When the handle is moved to the **LEFT** toward the long hood end, the locomotive will move in that direction when power is applied. With the handle in **NEUTRAL** (centered), mechanical interlocking prevents movement of the Dynamic Brake handle, but the Throttle handle can be moved. In such a case, power will not be applied to the traction motors.

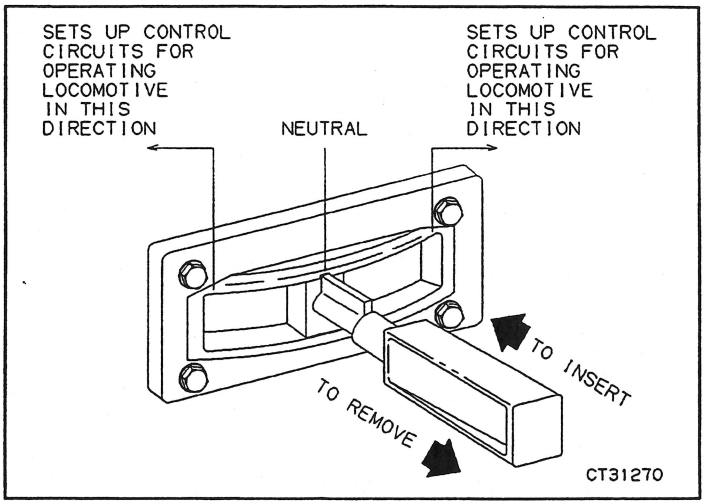

SETS UP CONTROL CIRCUITS FOR OPERATING LOCOMOTIVE IN THIS DIRECTION
NEUTRAL
SETS UP CONTROL CIRCUITS FOR OPERATING LOCOMOTIVE IN THIS DIRECTION
TO INSERT
TO REMOVE
CT31270

Figure 2-6. Directional (Reverser) Handle

The Directional (Reverser) handle is in **NEUTRAL** and removed from the panel to lock the Throttle handle in **IDLE** position and the Dynamic Brake handle in **OFF** position.

MECHANICAL INTERLOCKS ON THE CONTROLLER

The handles on the Locomotive Controller are interlocked so that:

1. With Directional (Reverser) handle in **NEUTRAL** (centered) -
   a. Dynamic Brake handle cannot be moved out of **OFF** position.
   b. Throttle can be moved to *any* position.
   c. Directional (Reverser) handle can be removed from controller if throttle is in **IDLE** position.
2. Directional (Reverser) handle in **LEFT** (Reverse) or **RIGHT** (Forward) -

a. Throttle handle can be moved to *any* position when Dynamic Brake handle is in **OFF** position.
b. Dynamic Brake handle can be moved to *any* position when Throttle handle is in **IDLE** position.

3. Directional (Reverser) handle removed from controller -

   a. Throttle handle is locked in **IDLE** position.
   b. Dynamic Brake handle is locked in **OFF** position.

4. Throttle handle in **IDLE** position -

   a. Dynamic Brake handle can be moved to *any* position when Directional (Reverser) is in **LEFT** (Reverse) or **RIGHT** (Forward) position.
   b. Directional (Reverser) handle can be set in **NEUTRAL** (centered), **LEFT**, or **RIGHT** position if Dynamic Brake handle is in **OFF** position.

5. Throttle handle above **IDLE** position -

   a. Dynamic Brake handle cannot be moved.
   b. Directional (Reverser) handle cannot be moved.

6. Dynamic Brake handle in **OFF** position -

   a. Throttle handle can be moved to *any* position.
   b. Directional (Reverser) handle can be moved to *any* position when throttle handle is in **IDLE** position.

7. Dynamic Brake handle moved out of **OFF** position -

   a. Throttle handle cannot be moved out of **IDLE** position into power positions, but can be moved into **STOP** position.
   b. Directional (Reverser) handle cannot be moved out of **LEFT** (Reverse) or **RIGHT** (Forward) into **OFF** position.

AIR BRAKE EQUIPMENT

The locomotive is equipped with type 26LUM air brake equipment. Controls for this equipment, located on the Operator's Control Stand shown in Figure 2-2, page 2-4, include an automatic brake, independent brake, cut-off pilot valve, a trainline air pressure adjustment valve, and a multiple unit (**MU-2A**) valve.

30A-CDW BRAKE VALVE

The **30A-CDW** Automatic and Independent Brake Valve system combines three controls in a single housing. Handles are operated in a left-to-right motion, the brakes being released at the left position. Operating positions are detented for positive location.

CUT-OFF PILOT VALVE

The Cut-Off Pilot Valve, Figure 2-7., on page 2-13, is provided for the purpose of cutting the Automatic Brake Valve in or out, depending on service application of the unit. The valve, located on the top of the brake valve housing, has three positions - **PASS (passenger), FRT (freight)**, and **OUT**. To change positions, pull up on the knob on the cut-out valve lever. Following is a description of the valve lever positions:

1. **PASS (Passenger)** position is used when locomotive is the lead (controlling) unit in a consist. In this position, brake valve is set for *gradual application* of brakes and *gradual release*. (In this position, the equalizing reservoir is maintained against leakage regardless of brake handle position.)

2. **FRT (Freight)** position is also used in lead unit operation. In this position, Automatic Brake Valve is set for *gradual application* of brakes and *instant release* from the **REL (Release)** handle position.

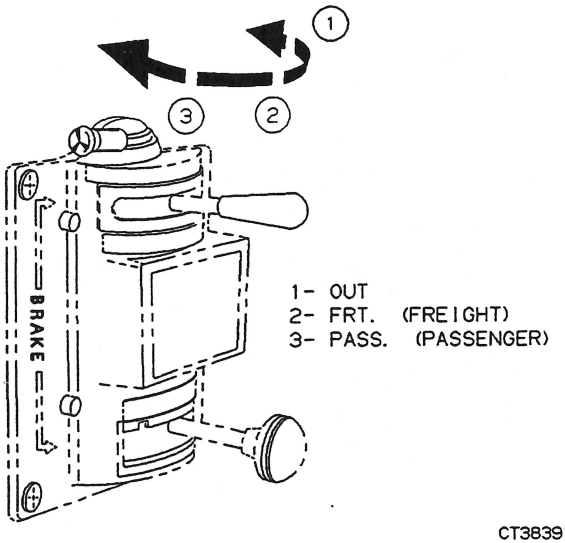


Figure 2-7. Cut-Off Pilot Valve.

3. **OUT** position blocks operation of Automatic Brake Valve and is used when unit is trailing in a consist (M.U.'d or when being hauled "***dead***" in a train) and, when required, to conduct a brake pipe leakage test.

NOTE

The **OUT** position does not prevent emergency brake application by the Automatic Brake Valve.

AUTOMATIC BRAKE VALVE HANDLE

The Automatic Brake Valve handle, Figure 2-8., on page 2-14, controls the application and release of both the locomotive and train brakes. The brake valve is of the "pressure maintaining type" which will hold brake pipe reductions constant against normal brake pipe leakage.

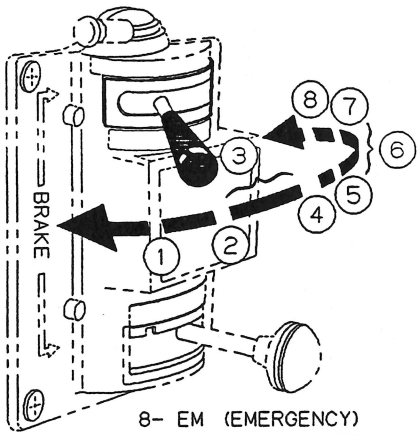


Figure 2-8. Automatic Brake Valve Handle.

Following is a description of the operating positions of the Automatic Brake Valve handle:

1. **REL (Release)** position is for releasing the locomotive and train brakes, and to enable charging brake equipment. It is located with the handle moved to the extreme left position (first detent) in the quadrant. Also, valve handle is placed in this position when adjusting the trainline air pressure (page 2-18).

2. **MIN (Minimum Reduction)** position is located with the handle in the second detent to the right of the **REL** position. With the handle moved to this position, minimum braking effort is obtained with a minimum reduction of brake pipe pressure (50 kPa).

3. SERVICE ZONE is the sector of handle movement to the right of the **REL** position. In moving the handle through the service zone, brake pipe pressure drops and braking effort is increased.

4. **F-S (Full Service)** position is located by the handle in the third detent position. In this position, full service braking is obtained by a full brake pipe pressure reduction.

5. **SUP (Suppression)** position is located by the handle in the fourth detent to the right of the **REL** position. In addition to providing full service braking effort, as with the handle in **F-S** position, setting handle in this position after initiation of an overspeed control or penalty brake application causes the brake valve to suppress the application. However, this must be done before expiration of a predetermined delay period (warning alarm will sound during delay).

6. OVER REDUCTION ZONE is used to obtain brake pipe pressures below the full service level. As handle is moved through this zone, brake pipe pressure drops and brake effort increases.

WARNING

Train should NOT be permitted, under any circumstances, to continue in operation if brake pipe pressure falls below level minimum specified by railroad rules. In such cases, the train must be stopped and the brake pipe recharged to the prescribed setting before proceeding.

7. **H O (Handle Off)** position is located by the handle in the fifth detent to the right of the **REL** position. The handle is placed and left in this position when locomotive is to be used as a trailing unit or hauled "dead" in a train. As handle is set in this position, a brake pipe pressure reduction is made.

WARNING

After brake pipe pressure reduction is completed (brake pipe air exhaust noise stops), be sure that brake cylinder pressure is applied to the locomotive, and that the proper procedures are followed for cutting out brake operation control on the locomotive.

8. **EM (Emergency)** position is located by the handle in the sixth detent, or extreme right position in the quadrant (away from the operator). It is this position that must be used to initiate emergency brake applications by venting brake pipe pressure to zero at the fastest possible rate (with brake valve cut-in or cut-out), and for resetting after any emergency brake application has occurred.

NOTE

A separate "conductor's" emergency brake valve is provided on the helper's (left side) of the cab.

INDEPENDENT BRAKE VALVE HANDLE

The Independent Brake Valve handle, Figure 2-9., on page 2-17, located directly below the Automatic Brake Valve handle, controls locomotive brake cylinder pressure independent of the Automatic Brake Valve. It also provides independent control of the braking effort of all locomotives in consist irrespective of train braking effort. The brake valve is self-lapping and will hold the locomotive brakes applied.

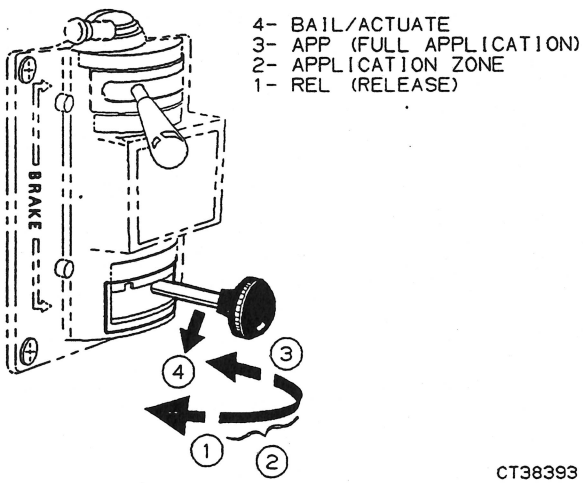


Figure 2-9. Independent Brake Valve Handle.

Following is a description of the operating positions of the Independent Brake Valve handle:

1. **REL (Release)** position is located with the handle moved to the extreme left position (first detent) in the quadrant. This position releases the locomotive brakes, provided that the Automatic Brake handle is also in the **REL (Release)** position.
2. APPLICATION ZONE is sector of handle movement to the right of the **REL** position. In moving the handle through the application zone, the degree of locomotive braking effort is increased.
3. **APP (Full Application)** position is located with the handle moved to the extreme right position in the quadrant (away from the operator). In this position, full locomotive application braking is obtained.
4. BAIL/ACTUATE function. Depressing the Independent Brake handle down, whenever the handle is in **REL** position, will cause the release of any Automatic Brake application existing on the locomotive.

NOTE

In order to ensure complete release, handle should be held in the depressed position for approximately four (4) seconds for each locomotive in the consist, after the brake pipe exhaust has stopped.

Depression of the Independent Brake handle, when in the APPLICATION ZONE, will release automatic application of the locomotive brakes to the value corresponding to the position of the Independent Brake handle.

TRAINLINE AIR PRESSURE ADJUSTMENT VALVE

The Trainline Air Pressure Adjustment Valve, Figure 2-2. , on page 2-4, is located to the left of the brake valve housing with access from the side of the control stand. It is used to adjust the equalizing reservoir pressure and, in turn, the brake pipe pressure to the required level.

When setting the pressure, the Automatic Brake Valve handle must be in the **REL (Release)** position. The set pressure will be indicated on the Equalizing Reservoir Pressure Gauge located on the Control Stand Gauge Panel. The Automatic Brake Valve will maintain the selected pressure against overcharging and/or leakage.

MU-2A VALVE

The **MU-2A** (multiple unit) Valve, shown in Figure 2-10., on page 2-19, is located at the lower left side of the control stand. It pilots the F1 selector valve, which is a device that enables the air brake equipment of one locomotive unit to be controlled by that of another unit.

The **MU-2A** Valve has two (2) operating positions, which are as follows:

LEAD OR DEAD

This position is used when the locomotive is the ***"lead"*** unit or hauled ***"dead"*** in a train.

TRAIL

This position is used when the locomotive is a trailing unit in a multiple unit consist.

The valve setting is changed by pushing the valve handle inward, then turning it to the desired position. Position selected will be that which is compatible with the brake system of the controlling unit.

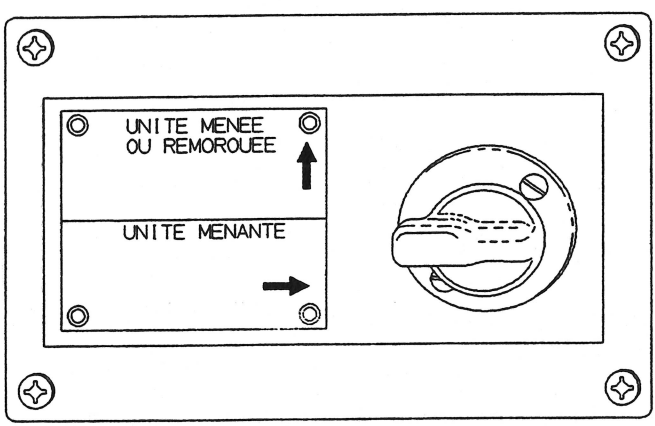


Figure 2-10. Typical MU-2A Multiple Unit Valve.

DEAD ENGINE FIXTURE

The 26LUM air brake system can be set up to limit air brake effort on a unit with a dead engine (being hauled "dead-in-train"). A dead engine fixture, shown in Figure 2-11, is provided for this purpose. This fixture is part of the air brake equipment located under the cab floor on the operator's side of the locomotive. Set the fixture as directed by Air Brake Equipment Settings Table, page 2-21.

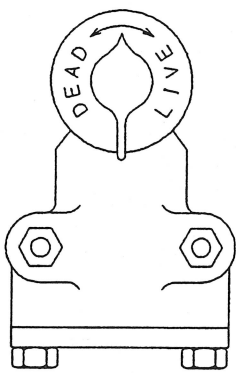


Figure 2-11. Dead Engine Fixture

26LUM AIR BRAKE EQUIPMENT OPERATING POSITIONS

In the absence of specific instructions, usually issued by the railroad to cover their recommended practices, refer to Table 2-1., on page 2-21, for brake equipment operating positions most often encountered while the locomotive is in service.

Table 2-1. Typical Air Brake Equipment Settings

Service ⇩	Automatic Brake Valve	Independent Brake Valve	Cutoff Pilot Valve	Dead Engine Fixture	26F Control Valve	MU2A Valve
SINGLE LOCOMOTIVE EQUIPMENT						
Lead	Release	Release	FRT or PASS	Live	Graduated Direct	Lead Or Dead
Shipping Dead In Train	Handle Off Position	Release	Out	Dead	Direct	Lead Or Dead
MULTIPLE LOCOMOTIVE EQUIPMENT						
Lead	Release	Release	FRT or PASS	Live	Graduated Direct	Lead Or Dead
Trail	Handle Off Position	Release	Out	Live	Graduated Direct	Trail
Shipping Dead In Train	Handle Off Position	Release	Out	Dead	Direct Release	Lead Or Dead

AIR HORN "JOY STICK" SWITCH

The air horn "joy stick" switch is used to control the "three chime" *road* air horn, mounted on the roof of the locomotive. Moving (pushing) the switch handle forward or backward activates the *road* air horn.

BELL Push-Button Switch

This switch is used to operate the locomotive signal bell. The basic switch is a latching type device with separate illuminated "orange" **ON** and **OFF** push-buttons. Pressing the **ON** button causes the locomotive bell to ring until the **OFF** button is pressed.

> **NOTE**
> The locomotive signal bell is also activated by operation of the air horn "joy stick" switch or the horn sequencer push-button switch. Activation of the signal bell by a horn switch requires the bell be silenced using the bell **OFF** button.

HORN SEQUENCER Push-Button Switch

This switch is used to activate the unit's air horn to sound a Rule 14L sequence. In addition, activation of this push-button switch will cause the headlights to go to full bright, the ditch lights to turn on, and the signal bell to ring. The switch is a latching type device which must be pressed a second time to enable the bell, headlights, and ditch lights to revert to their previous state.

DUPLEX AIR PRESSURE Gauges

The two (2) duplex air pressure gauges, Figure 2-12, located at the center of the front instrument panel, indicate various air brake system pressures:

The gauge to the left indicates:
Red Hand; MAIN RESERVOIR PRESSURE
White Hand; EQUALIZING RESERVOIR PRESSURE

The gauge to the right indicates:
Red Hand; BRAKE CYLINDER PRESSURE
White Hand; BRAKE PIPE PRESSURE

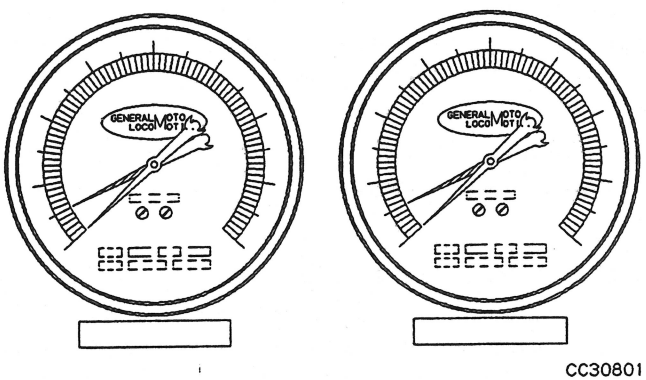


Figure 2-12. Duplex Air Pressure Gauges

AIR FLOW Indicator

This air gauge, located immediately to the right of the duplex air gauges, provides an indication of the brake system charging rate as well as any abnormal air supply leakage, break-in-two, or rear-end of train brake applications.

ROAD NUMBER PLATE (Indicator)

This rectangular plate indicates the unit road number. This indicator is NOT illuminated.

LOAD CURRENT INDICATING Meter (Ammeter)

The load current indicating meter, Figure 2-13, page 2-25, displays average traction motor current levels during motoring and dynamic braking. Tractive and dynamic brake effort levels vary with traction motor current level.

The meter has a "zero-center" movement with needle swing to the right from zero to indicate **POWER** (motoring) current level, and swing to the left from zero to indicate (dynamic) **BRAKE** current level. Color rings on the meter face, concentric with the meter scale, provide information about the current level being indicated by the meter needle

The maximum scale indication is 1650 A in power and 1000 A in dynamic brake. Since the control system computer regulates dynamic braking current, the maximum current reading on the meter should seldom (if ever) indicate more than 945 amperes, which is the rating of the extended range dynamic braking resistor grids

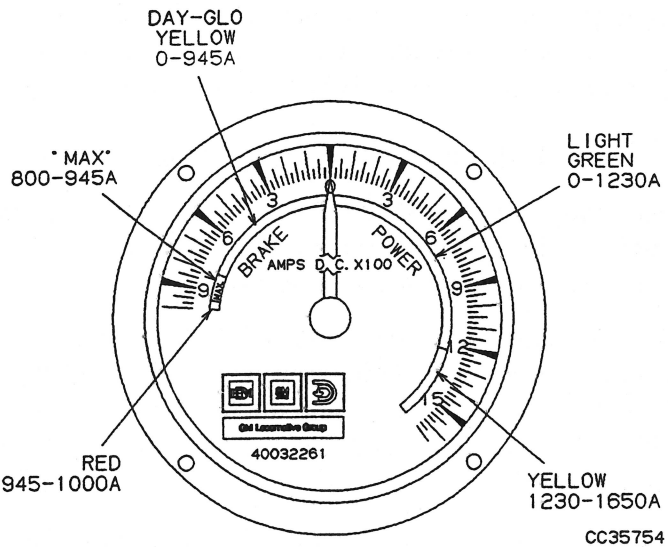


Figure 2-13. Load Current Indicating Meter.

SLOW SPEED CONTROL Rocker Switch

This switch (*on the control stand*) is used in conjunction with the locomotive computer display panel (*in the overhead console*) to enable the operator to activate and control the Slow Speed System. This rocker type switch has three positions: **UP**, centered (**OFF**), and **DOWN**. The switch **UP** position requests the computer to raise locomotive Set Speed. The **DOWN** position requests a lower Set Speed. When the rocker is released, spring pressure returns it to the centered (**OFF**) position.

Refer to SLOW SPEED CONTROL OPERATION in OPERATION Section 3 for more information.

CONTROL AND OPERATING SWITCHES

The control and operating switches are located on the upper portion of the switch panel at the right side of the operator's control stand, Figure 2-2. , on page 2-4. Panel switch descriptions are as follows:

ENG (Engine) RUN Slide-Button Switch

This switch must be **ON** when unit ***leads*** in a consist, and must be **OFF** when unit ***trails*** or is ***dead*** in a consist. Switch is **ON** when slide-button is **UP**.

When the **ENG RUN** switch is **ON**, the locomotive control system controls diesel engine speed according to throttle handle position. When the **ENG RUN** switch is **OFF** (down), engine speed is not affected by throttle handle position.

GEN (Generator) FLD (Field) Slide-Button Switch

This switch must be **ON** when unit ***leads*** in a consist, and must be **OFF** when unit ***trails*** or is ***dead*** in a consist. Switch is **ON** when slide-button is **UP**.

When the **GEN FLD** (generator field) switch is **ON**, the locomotive control system provides main generator field excitation as required. When the **GEN FLD** switch is **OFF**, the throttle handle will still control engine speed, but the system will not provide main generator excitation and, therefore, the main generator will not develop output power.

FP (Fuel Pump) & CONT (Control) Slide-Button Switch

This switch must be **ON** when unit ***leads*** in a consist, and must be **OFF** when unit ***trails*** or is ***dead*** in a consist. Switch is **ON** when slide-button is **UP**.

When the **FP & CONT** (fuel pump and control) switch is **ON**, it provides power to various low voltage control circuits. The switch must be **ON** to start the diesel engine and operate the fuel pump.

ALARM SILENCER Push-Button Switch

This push-button switch is used to silence the electronic sound alarm located in the Operator's Overhead Console and an external alarm mounted on the underframe, just below the left side sill. When this button is pressed, the alarms are silenced on that unit, but NOT on other train-lined units in a consist. An indicator light within the "red" push-button will also turn **ON**, and remain lit (even though alarms are silenced) until the cause of the alarm is corrected.

DITCH LIGHTS Switches

These two (2) position (**ON** and **OFF**) switches are provided to allow manual control of the two (left and right) ditch lights (separate from the headlights) at both the front and rear of the unit. The corresponding **HDLTS.** (Headlights) switch (**FRONT** or **REAR**) must be in the **BRT.** (Bright) position to enable turning the ditch lights **ON**. The ditch lights are to be operated in accordance with railroad rules and/ or government regulations.

HDLTS. FRONT Rotary Switch

This switch is used to control the headlights at the front (short hood) end of the unit.

The switch has the following four (4) positions:

- OFF: Headlights and ditch lights are shut **OFF**.
- DIM: Headlights **ON** dimly.
- MED: Headlights lights **ON** at medium intensity.
- BRT: Headlights lights **ON** at maximum intensity.

MISCELLANEOUS SIDE PANEL SWITCHES

GAUGE LIGHTS Slide-Button Switch

This switch is used to control all device lighting in the control stand; including the gauge lights, the handle position indicating light in the controller, and the lights in the slide-button switches. The lights will be **ON** when switch slide-button is **UP.**

PLATFORM LIGHTS Slide-Button Switch

This switch is used to provide **ON/OFF** control of the platform lights at the front and rear of the locomotive. With the slide-button in the **ON** (up) position, power is supplied to the platform lights.

NUMBER LIGHTS Slide-Button Switch

This switch is used to provide **ON/OFF** control of the road number lights at the front of the locomotive cab above the windshields. With the slide-button in the **ON** (up) position, power is supplied to the lights.

GROUND LIGHTS Slide-Button Switch

This switch controls the ground lights at either side of the unit below the cab. The lights will be **ON** when switch slide-button is **UP.**

STEP LIGHTS Slide-Button Switches

These switches control the step lights on either side at the front of the unit. The lights will be **ON** when switch slide-button is **UP.**

NOTE

LIGHTS breaker on the No. 1 Circuit Breaker Panel in the Electrical Control Cabinet must be **ON** (up) to operate the gauge, platform, number, ground or step lights.

GAUGE LIGHTS DIMMER Rheostat

This dimmer rheostat is used to control the intensity of the lights in the air gauge complex, load current indicating meter, as well as the illuminated slide-button switches in the control stand.

TMS RESET Push-Button Switch

This "yellow" mushroom head push-button switch, located immediately to the right of the brake valve, is used to signal the Train Monitoring (vigilance) System. The operator is required to actuate this switch (or a reset foot switch) in accordance with specified time intervals, as a manual supplement to normal operation reset actions including: changes in Throttle, Dynamic Brake, or Directional handle positions, application of the Automatic or Independent air brakes, and/ or operation of the unit's air horn or communications radio.

MANUAL SAND Push-Button Switch

When operated (at speeds under 9 MPH), this "yellow" flush head push-button switch provides a signal to the sanding input of the control computer. The computer determines which direction the locomotive is moving and directs the trainlined signal to the appropriate (forward or reverse) sanding magnet valves. The basic switch is a non-latching push-button type device.

Manual sand is cut out when the locomotive is operating with power in Super Series Mode, and moving above 9 MPH. However, if a Super Series locomotive is in consist with older units, pressing the manual sand push-button will supply a trainlined signal to the older units and sand will be applied. ***Manual sanding is available in dynamic braking regardless of speed.***

LEAD TRUCK SAND Push-Button Switch

When operated (at speeds under 15 MPH), this "yellow" flush head push-button switch will provide a signal to the sanding input of the control computer. The computer determines which direction the locomotive is moving and directs a signal to the appropriate sanding magnet valve at the lead truck position only. The basic switch is a non-latching push-button type device.

Lead Truck Sand is cut out when the locomotive is operating with power in Super Series Mode, and moving above 15 MPH. ***Lead Truck sanding is available in dynamic braking regardless of speed.***

HDLTS. REAR Rotary Switch

This switch is used to control the headlights at the rear (long hood) end of the unit. Its four (4) positions are:

- OFF: Headlights are shut **OFF**.
- DIM: Headlights **ON** dimly.
- MED: Headlights **ON** at medium intensity.
- BRT: Headlights **ON** at maximum intensity.

NOTE

HDLTS. breaker on the No. 1 Circuit Breaker Panel in the Electrical Control Cabinet must be **ON** (lever up) to operate either the front (short hood) or rear (long hood) headlights.

HEATER Rotary Switch

This switch is used to control the cab heating and ventilation system; it has seven (7) positions - **OFF, VENTILATION 1 and 2, and HEATING 1 THRU 4.** The fan operates in two speeds (**LOW** and **HIGH**).

Note: The **CAB HEATER** breaker on the No. 2 circuit breaker panel in the Electrical Control Cabinet must be **ON** (lever up) to enable Cab Heating Unit operation.

ATTENDANT CALL Push-Button Switch

This momentary contact switch, when operated, will activate the electronic sound alarm in the cab of this unit, and on all trainlined units in the consist.

SPEED Indicator

A "*master*" speed indicator, Figure 2-14. , on page 2-32, in combination with an events recorder system, is provided to assist in the operation of the locomotive within the prescribed railroad rules. Locomotive speed is indicated on the unit's dial display in a range of 0 to 80 MPH. The speed indicator unit is provided with standard "accelerometer" feature and is contained in a housing which is mounted in front of the operator on the front wall of the cab immediately below the windshield.

NOTE

An additional speed indicator is provided at the left (helper's) side of the cab, located in the overhead console area.

The speed signal for the unit originates from a traction motor speed probe through an isolation amplifier. An overspeed protection feature is included which is set at 72 MPH. When activated, this feature initiates an audible time delay warning with a warning light, followed by power reduction and a penalty brake application.

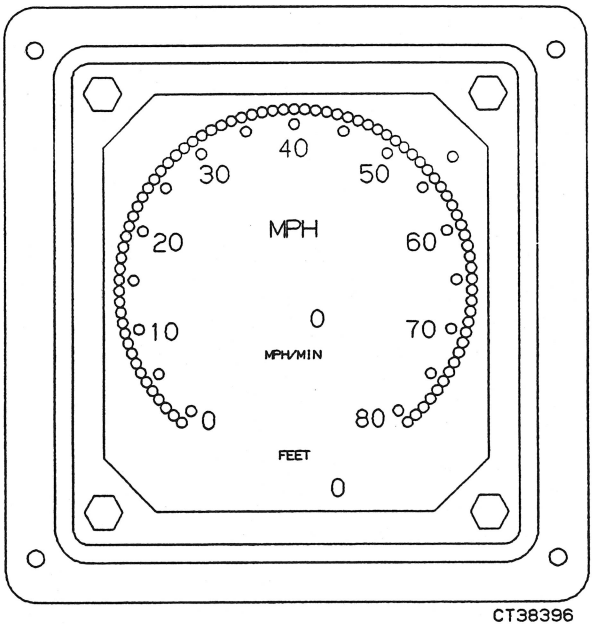


Figure 2-14. Typical Speed Indicator

The speed indicator is provided with backlighting which can be controlled for intensity by a dimmer rheostat located adjacent to the indicator housing.

Control Stand Miscellaneous Devices

Figure 2-2, page 2-4, illustrates the Operator's Control Stand. Descriptions of components not previously covered are as follows:

INPUT & DISPLAY UNIT (IDU)

Provision is made for installation of a Trainline Information and Braking System (TIBS) display unit in the upper left portion of the Operator's Control Stand.

RADIO CONTROL MODULE

A two-way radio control unit is located in the upper left portion of the Operator's Control Stand. This radio (transceiver) contains the necessary controls to communicate with other trains and wayside installations using the "handset" located in a hang-up cup (cradle) at the far left side of the Control Stand.

NOTE

A remote radio speaker with separate volume control and "handset" are also provided at the left "helper's" side of the cab. The volume control is located at the far left side of the Overhead Console. The handset is at the right side of the helper's work station desk top.

TMS RESET Foot Switch

This foot switch is used to signal the Train Monitoring (vigilance) system in the same manner as the TMS RESET push-button switch described on page 2-29.

OVERHEAD CONTROL CONSOLE

Devices that must be within reach of the operator and/ or helper, but are not mounted on the Operator's Control Stand or the Helper's Work Station, are located on the Overhead Control Console, Figure 2-15, page 2-35. Overhead Console devices are described, beginning at the left (helper's) side of the cab, as follows:

READING LIGHT Toggle Switch & DIMMER Rheostat

The switch is used to provide **ON/OFF** control of the adjustable "ball" type reading light over the helper's work area.

The dimmer rheostat is used to control the intensity of this reading light.

HELPER'S SPEED Indicator

The helper's speed indicator functions in a similar manner to the "*master*" unit (w/o overspeed protection feature) which is located at the Operator's Control Stand. See description of "*master*" unit, on page 2-31.

The helper's speed indicator is provided with backlighting which can be controlled for intensity by a dimmer rheostat located in the Overhead Console adjacent to the indicator housing.

SHORT HOOD LIGHTS Toggle Switch

This switch is used to provide **ON/OFF** control of the lights in the short hood entrance and equipment areas.

Note: **LIGHTS** circuit breaker in the No. 1 Electrical Control Cabinet must be **ON** (up) to enable short hood lights operation.

ROAD NUMBER PLATE (Indicator)

This illuminated rectangle displays the unit road number within view of all crew members in the cab. The indicator is illuminated when the **GAUGE LIGHTS** slide switch is **ON** (up) and the **LIGHTS** breaker on the No. 1 Circuit Breaker Panel is **ON** (up). The intensity of the light is controlled by a dimmer rheostat located at the operator's side of the Overhead Console.

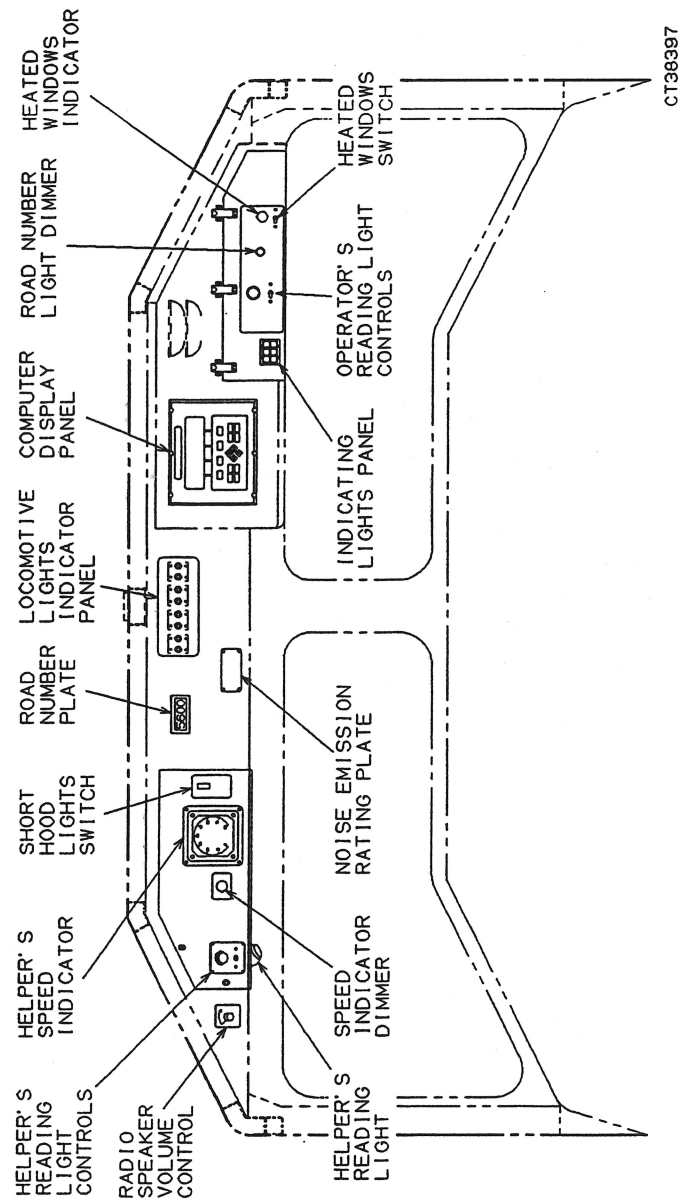


Figure 2-15. Overhead Control Console

LOCOMOTIVE LIGHTS INDICATOR PANEL

This indicator panel, located in the center of the Overhead Console, contains eight (8) lights which are used to indicate that the appropriate locomotive lights are **ON**. These lights are identified (from left to right) on the panel:

- REAR - LEFT DITCHLIGHT
- REAR - RIGHT DITCHLIGHT
- FRONT - LEFT DITCHLIGHT
- FRONT - RIGHT DITCHLIGHT
- REAR - LEFT HEADLIGHT
- REAR - RIGHT HEADLIGHT
- FRONT - BOTTOM HEADLIGHT
- FRONT - TOP HEADLIGHT

COMPUTER DISPLAY PANEL

The computer display panel, shown in Figure 2-16, page 2-37, includes a six (6) line/ 40 character-per-line display, and a 16 button data input keypad.

The display panel performs three important functions for the locomotive operating crew:

1. Displays locomotive status and fault messages.
2. Enables crew members to respond to/ reset, faults.
3. Enables crew members to perform certain tasks (such as traction motor cutout- using the data input keypad.

The display panel, along with the locomotive control computer, form the Display Diagnostics System (DDS). Refer to Troubleshooting Section 4 for further description.

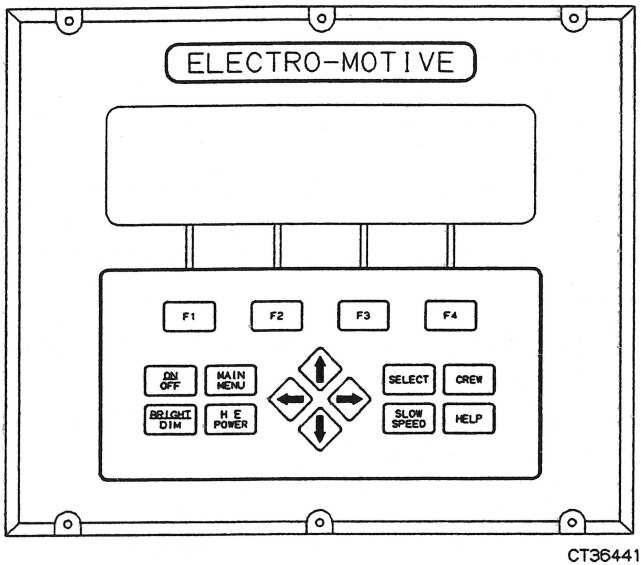


Figure 2-16. Computer Display Panel

ELECTRONIC SOUND ALARM (Sonalert)

An electronic sound alarm unit is located in the Overhead Control Console, immediately below the Computer Display Panel. (A second electronic alarm is located outside of the cab below the left side sill.)

This alarm will normally sound for one of the following reasons:

- Attendant Call button pressed.
- Trainline 2T is energized.
- Hot engine causing throttle 6 engine speed and load limitation. (Hot engine condition must exist for 5 minutes before alarm bell rings.)
- Truck 1 or Truck 2 filter blower motor failure.
- Engine shutdown while not in **ISOLATE**.
- Engine shutdown with cold engine water.

The electronic alarm unit in the cab is also used as the sound warning device with the Train Monitoring (vigilance) system.

TRAIN MONITORING (VIGILANCE) SYSTEM

This system checks operator alertness by requiring it be reset at specified time intervals (interval length varies with locomotive speed; faster locomotive speeds require more frequent resets).

Train Monitoring reset can be done using any one of the major operator controls, or the supplemental push-button or reset foot switches at the Control Stand. See page 2-29 for additional information.

If the operator fails to reset the Train Monitoring system in time, the system actuates the electronic sound alarm and a visual indicator. If the operator does not respond to the warnings by resetting the system, the system will initiate a power reduction followed by penalty braking.

NOTE

The train will be brought to a complete stop before the Train Monitoring system will reset following a system initiated penalty brake application.

INDICATING LIGHTS PANEL

Indicating lights alert the locomotive operator of various operating conditions. The panel assembly is located adjacent to the computer display panel in the Overhead Console. It has provision for six press-to-test lights (three basic, and from one to three additional as required by the use of special equipment on the locomotive).

NOTE

The following indicator lights have a push-to-test feature which allows testing of the lamp circuit alone, isolated from its operation in the power control system. When the lens cap is depressed, the supply voltage is impressed across the lamp circuit. After a one (1) second delay, the light should go **ON**.

WHEEL SLIP Light

Five different conditions can cause this "white" indicator light to come **ON**. Two of the conditions that cause the light to come **ON, LOCKED POWERED WHEEL** and **SLIPPED PINION**, are abnormal and possibly dangerous; ***they require immediate attention and action by the operating crew.*** The other three conditions, **WHEEL SLIP, WHEEL SLIDE**, and **WHEEL OVERSPEED**, do not require immediate crew action. The following text describes the five conditions in more detail.

1. **LOCKED POWERED WHEEL.** It takes ten (10) seconds for the locomotive computer to detect this fault. Then, for the next five (5) seconds; the **WHEEL SLIP** indicator light will be **ON** continuously, traction power will be cut off and the computer will display the **#N LOCKED POWER WHEEL** message. Computer then allows traction power to return, and turns off the indicator light and the displayed message. If throttle is not returned to **IDLE**, the cycle will repeat. **Note** that the **WHEEL SLIP** light is trainlined.

WARNING

A LOCKED POWERED WHEEL ON A MOVING LOCOMOTIVE IS VERY DANGEROUS. IF A LOCKED POWERED WHEEL IS INDICATED, PROCEED AS DIRECTED AFTER NEXT LISTED CONDITION; SLIPPED PINION.

2. **SLIPPED PINION.** If the locomotive computer senses this fault (traction motor spinning too freely), it causes the **WHEEL SLIP** indicator light to flash (cycle) **ON** and **OFF** (3 seconds on / 3 seconds off). In addition, the computer will display the **POSSIBLE SLIPPED PINION DETECTED/ VOLTAGE LIMITING IN ORDER TO VERIFY** message.

The **WHEEL SLIP** light on and off cycle and the computer message display will continue while the computer tests the suspect traction motor circuit to verify the fault (Low-level power is applied to the traction motors during this test - which requires up to four [4] minutes).

If the computer ***does not*** verify the slipped pinion fault; it cancels the fault and the computer message display, turns off the **WHEEL SLIP** indicator light, and re-enables normal locomotive operation.

If the computer ***does*** verify the slipped pinion fault; it drops out power and dynamic brake operation until the fault is reset, latches in the fault condition, it displays the **MOTOR #N SLIPPED PINION LOCKOUT** message, and it continues to cycle the **WHEEL SLIP** indicator light. The fault must be cleared before the computer will stop cycling the **WHEEL SLIP** indicator light.

PROCEED AS FOLLOWS IF A LOCKED POWERED WHEEL OR A SLIPPED PINION IS INDICATED:

a. STOP TRAIN.
b. DETERMINE WHICH OF THE UNITS HAS THE "LOCKED POWERED WHEEL" OR "SLIPPED PINION.
c. SLOWLY ROLL THE UNIT WITH THE INDICATION PAST AN OBSERVER WATCHING FOR SLIDING WHEELS AND/OR "BIRDNESTED" TRACTION MOTORS, WHILE LISTENING FOR

UNUSUAL NOISES FROM EITHER THE TRACTION MOTORS OR GEARCASES.

1) IF ANY WHEEL SLIDES, OR ANY TRACTION MOTOR APPEARS TO BE "BIRDNESTED," OR ANY TRACTION MOTOR OR A GEARCASE MAKES UNUSUAL NOISE, THEN CONTACT TRAIN DISPATCHER FOR FURTHER INSTRUCTIONS.

WARNING

DO NOT UNDER ANY CIRCUMSTANCES TOW A UNIT HAVING SLIDING OR LOCKED WHEELS, OR MOVE SUCH A UNIT IN A LOCOMOTIVE CONSIST.

2) IF ALL WHEELS ROLL FREELY, AND TRACTION MOTORS AND GEARCASES SOUND AND LOOK OK, THEN ATTEMPT TO RESUME OPERATION. IF A FAULT INDICATION RECURS, THEN CONSULT THE TRAIN DISPATCHER BEFORE PROCEEDING.

3. **WHEEL SLIP.** While starting a train ***when rail conditions are exceptionally poor***, an ***occasional*** flash of the indicator light indicates normal functioning of the system's wheelslip control, which may be accompanied by automatic sanding. Throttle reduction is not required unless severe lurching threatens to break train.

NOTE

When rail conditions are poor and the locomotive is operating in power above 1.5 MPH, ***occasional, irregular flashing*** of the **WHEEL SLIP** light may indicate a Super Series failure. Operation may continue, but the condition should be reported to authorized maintenance personnel.

4. **WHEEL SLIDE.** While operating in dynamic brake, ***intermittent flashing*** of the indicator light indicates normal functioning of the system's wheelslide control function, which may be accompanied by automatic sanding.

5. **WHEEL OVERSPEED.** The indicator light will flash **ON** and **OFF** (3 seconds on & 3 seconds off) to indicate wheel (and traction motor) overspeed, and the computer will display the **WHEEL OVERSPEED** message. This can be caused by excessive track speed or by simultaneous slipping of all wheels. In either case, the system automatically corrects by regulating main generator output power. The computer message and indicator light flashing are automatically cancelled after recovery.

PCS OPEN Light

The "red" **PCS OPEN** light comes **ON** to indicate a penalty or emergency air brake application. (Computer displays **NO LOAD - PCS OPEN** message, motoring/dynamic braking power is cut off, and diesel engine is limited to throttle 1 speed.) Normal operation is restored automatically when the following conditions are met:

1. Throttle is returned to the **IDLE** position.
2. Control of air brake is recovered (**PCS** resets).

SLOW SPEED Light

This "white" light will be **ON** when the slow speed control system is operating in the **CONTROL** mode. See "SLOW SPEED CONTROL Rocker Switch," page 2-25, for additional information. Also refer to SLOW SPEED CONTROL OPERATION in the OPERATION Section 3 for more information.

BRAKE WARN (Warning) Light

This "amber" light indicates excessive dynamic braking current. In the event that the **BRAKE WARN** light comes **ON, reduce dynamic brake handle position immediately to decrease braking effort and prevent possible equipment damage.**

If the **BRAKE WARN** light does not go out when dynamic brake handle setting is reduced, or if indication repeats, place the **DYN BRAKE** cutout switch (on affected unit's Engine Control Panel) to the **OFF** position. The unit will then operate normally in power, but not in dynamic brake. (Total dynamic braking effort of units coupled in consist will be reduced.) Computer will then display: **NO DYNAMIC BRAKE - DYNAMIC BRAKE IS CUT OUT** message.

READING LIGHT Toggle Switch & DIMMER Rheostat

The switch is used to provide **ON/OFF** control of the adjustable "ball" type reading light over the operator's work area.

A dimmer rheostat is used to control the intensity of this reading light.

ROAD NUMBER LIGHT DIMMER Rheostat

This dimmer rheostat is used to control the intensity of the unit road number plate (Indicator) located in the Overhead Console. The indicator is illuminated when the **LIGHTS** breaker on the No. 1 Circuit Breaker Panel is **ON** (up).

HEATED-WINDOWS Toggle Switch & INDICATOR Light

This switch, located in the Overhead Console on the operator's side of the cab, is used to control the electric windshield heaters. The heaters will be operating when the switch is in the **ON** position, provided that the **HEATED WINDOW** breaker on the No. 1 Circuit Breaker Panel is **ON** (up).

A "blue" indicator light, located above the switch, will be **ON** when power is applied to the windshield heaters.

Miscellaneous Cab Devices

OVERHEAD LIGHTING

Overhead lights are provided in locations appropriate for the designated work areas in "cab", "floor", "reading" and "housekeeping" (fluorescent) configurations.
ON/ OFF control switches are located on or near the lighting fixtures for local or remote control, and are labeled accordingly.

Note: **LIGHTS** circuit breaker on the No. 1 Circuit Breaker Panel must be **ON** (up) to enable cab lights operation.

WINDSHIELD WIPERS & CONTROLS

Wiper assemblies are provided for each windshield in front of (and each window behind) the operator's and helper's sides of the locomotive cab. Each wiper assembly is driven by an air operated motor which is controlled by its own air valve (switch). Front and rear wiper controls are provided on panels located in the ceiling at the operator's and helper's work stations.

NO. 1 ELECTRICAL CONTROL CABINET

The No. 1 Electrical Control (High Voltage) Cabinet forms the rear partition of the locomotive cab and contains various devices for operating the locomotive. Figure 2-17, page 2-46, shows the panels and compartments for the devices used by the operator.

The No. 1 Electrical Cabinet operator device descriptions are grouped under these headings:

- Engine Control Panel, page 2-46
- No. 1 Circuit Breaker Panel, page 2-51
- No. 2 Circuit Breaker Panel (Compartment), page 2-59
- Fuse & Switch Panel (Compartment), page 2-61
- Fuse Test Equipment, page 2-63

WARNING

Never open a No. 1 Electrical Control Cabinet door other than to gain access to the circuit breaker panels or fuse & switch panel. **High voltage and current** are present at various locations within the Cabinet.

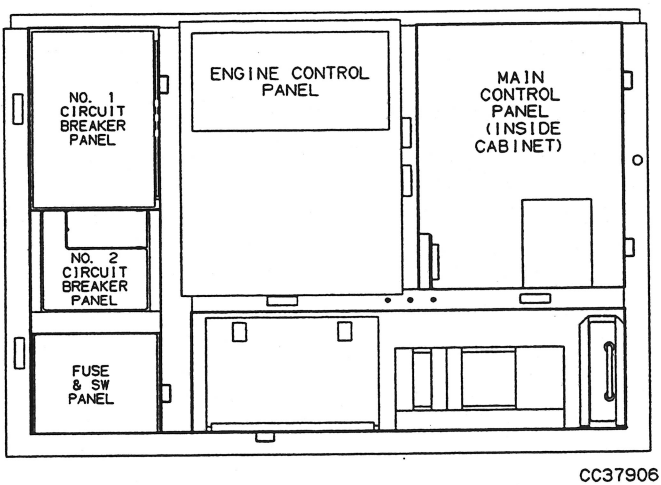


Figure 2-17. Typical No. 1 Electrical Control (HVC) Cabinet Panels

ENGINE CONTROL PANEL

The Engine Control Panel, Figure 2-18, page 2-47, contains control equipment used in locomotive operation. A description of each device follows:

HEADLIGHT CONTROL Rotary Switch

The Headlight Control Switch, also known as the "Remote Headlight" Control switch, enables the lead unit to control headlight operation of the rear unit in a consist.

Figure 2-18. Typical Engine Control Panel

Set switches according to unit's position in consist:

- On Lead Unit -
  - If locomotive is to operate without other locomotives, use **SINGLE UNIT OR INTERMEDIATE UNIT** position.
  - For multiple unit service, with trailing units coupled to No. 2 or long hood end of lead unit, use **CONTROLLING WITH UNIT COUPLED AT LONG HOOD END** position.
  - For multiple unit service, with trailing units coupled to No. 1 or short hood end of lead unit, use **CONTROLLING WITH UNIT COUPLED AT SHORT HOOD END** position.
- On Intermediate Units -
  - For unit operating between other units in a multiple unit consist, use **SINGLE UNIT OR INTERMEDIATE UNIT** position.
- On Trailing Units -
  - For last unit in a multiple unit consist, use **CONTROLLED FROM ANOTHER UNIT COUPLED AT EITHER END** position.

Note: Control Stand **HDLTS. FRONT** and **HDLTS. REAR** switches control headlight **ON/OFF** and light intensity. **HDLTS.** breaker on No. 1 Circuit Breaker Panel must be **ON** (up) before headlight controls will function.

ISOLATION TAG HOOK

This hook is used to hold the **DO NOT START ENGINE/LEAVE THIS ENGINE ISOLATED** tag over the Isolation Switch. A similar hook is located on the Engine Start Switch in the engineroom.

AMMETER (Battery Charging)

The battery charging ammeter is a "zero-center" type meter which indicates the status of charge or discharge of the storage batteries. With the main battery knife switch closed, the ammeter is connected into the low voltage circuits to indicate current flow to the batteries (needle swing to the right "green" portion of the dial) and from the batteries (needle swing to the left "red" portion of the dial). The battery charging ammeter does not indicate the auxiliary generator output, or the engine cranking current during start-up.

ISOLATION Rotary Switch

This switch has two (2) positions; one labeled **START/ STOP/ ISOLATE**, and the other labeled **RUN**. The functions of these positions are as follows:

START/ STOP/ ISOLATE Position

- Enables diesel engine priming and starting.
- Isolates unit. When isolated, unit will not develop power or respond to controls; engine runs at idle speed regardless of throttle handle position.
- Silences alarm caused by conditions monitored by the locomotive control computer. Does <u>not</u> silence alarm caused by hot engine.

NOTE

Locomotive is equipped for computer-controlled traction motor cutout. Isolation switch must be set to the **START/ STOP/ <u>ISOLATE</u>** position to enable traction motor cutout. Refer to "T.M. CUTOUT & TRUCK DISABLED" in TROUBLESHOOTING Section 4 for more information.

RUN Position

- Puts unit on line after engine has been started. Unit then responds to control and develops power in normal operation.

EMERGENCY FUEL CUTOFF & ENGINE STOP Push-Button Switch

The diesel engine will stop whenever the engine stop push-button is pressed and held in for approximately one (1) second. It need not be held in until the engine stops; however, holding button in for one (1) second ensures that the computer recognizes the switch actuation as a proper shut-down signal.

DYN (Dynamic) BRAKE Cut Out Slide Switch

When this switch is set in the **OFF** (down) position, the unit will not provide dynamic braking. It will, however, continue to operate normally in power. The switch can be used to limit the number of units coupled together that will provide dynamic braking, or it may be used to cutout dynamic braking on a unit that has a defect, while still allowing it to operate under power.

Normally this switch is safety wired in the **ON** (up) position to discourage inadvertent actuations.

DYN. BRK. CONT. CB (Dynamic Brake Control Circuit Breaker)

This slide switch type circuit breaker is provided to protect against faulty operating or test setups. The circuit breaker should be in the **ON** (up) position for normal operation. A tripped circuit breaker usually indicates that, during dynamic brake testing, more than one Dynamic Brake handle in a locomotive consist was out of the **OFF** position.

ENGINE ROOM Lights Slide Switch

This switch is used to provide **ON/OFF** control of the engineroom (maintenance) lights in the inertial filter compartment, and the equipment rack, air compressor and #2 traction motor blower areas at the governor end of the engine.

HVC (High Voltage Cabinet) Lights Slide Switch

This switch is used to provide **ON/OFF** control of the electrical cabinet interior lights. There are five (5) lights in the No. 1 Electrical Control Cabinet, and two (2) each in the No. 2 and No. 3 AC Cabinets. These lights are provided for use by the maintenance crew during routine inspections or repairs.

FRESH AIR MAKE UP BLOWER Slide Switch

This switch is used to provide **ON/OFF** control for operating the Cab Fresh Air Make Up Blower. With the slide-button in the **ON** (up) position, power is supplied to the blower, provided that the engine is running and the **FRESH AIR M/U** breaker is in the **ON** (up) position.

NO. 1 CIRCUIT BREAKER PANEL

The No. 1 Circuit Breaker Panel, Figure 2-19. , on page 2-52, contains circuit breakers and switches that protect basic locomotive equipment and control systems, as well as those used to protect requested extra equipment. Most of these circuit breakers can be operated as switches, but also will automatically trip open when an overload occurs. The panel is divided into sections:

- The **"white"** labeled sections of the panel contain breakers that are used as conditions require.
- The **"black"** labeled sections of the panel contain breakers that must be **ON** (lever up) during locomotive operation.

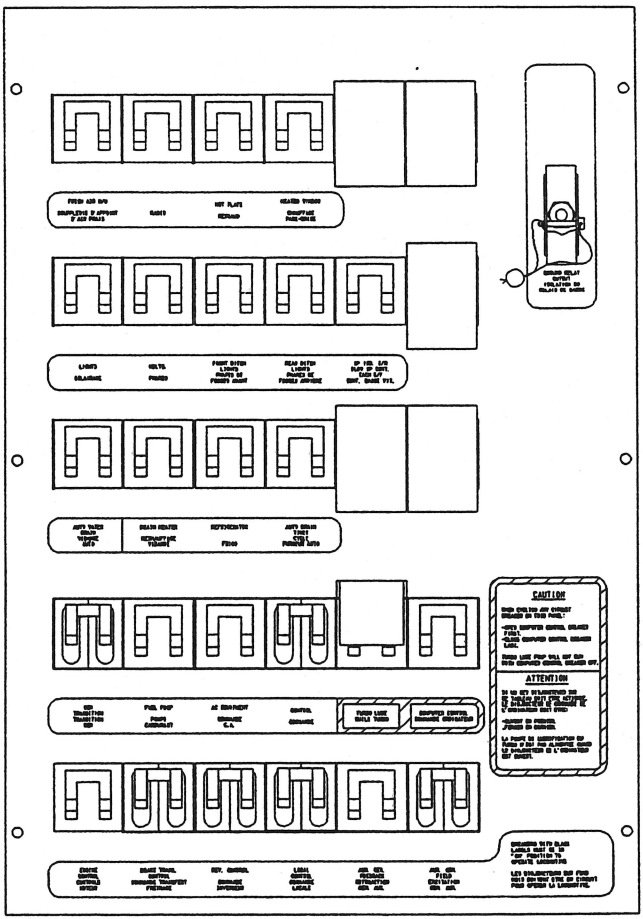


Figure 2-19. Typical No. 1 Circuit Breaker Panel

CAUTION

When cycling any circuit breaker on this panel, place the Computer Control breaker in the **OFF** (down) position first, cycle the breaker, then return the Computer Control breaker to the **ON** (up) position.

Circuit breakers and switches in the "white" labeled section include:

FRESH AIR M/U (Make Up) Circuit Breaker

This breaker must be **ON** (lever up) to supply power to the fresh air make up blower, and the **FRESH AIR MAKE UP BLOWER** Slide Switch on the Engine Control Panel.

RADIO Circuit Breaker

This breaker must be **ON** (lever up) to provide power and protection to the unit's two way radio communications equipment.

HOT PLATE Circuit Breaker

This breaker provides protection for the circuit which supplies power through a receptacle to the helper's Hot Plate. This appliance is provided with a power cord, heating element and control which will be protected by this breaker.

HEATED WINDOW Circuit Breaker

This breaker must be **ON** (lever up) to supply power to the heating elements in each (left and right) windshield section, as well as the **HEATED-WINDOWS** Toggle Switch and Indicator Light on the switch panel at the operator's side of the Overhead Console.

GROUND RELAY CUTOUT Toggle Switch

The purpose of the ground relay cutout switch is to disconnect the ground relay during certain shop maintenance inspections. **It must always be kept closed (lever up) to enable normal locomotive operation.** If the switch is opened (lever down), it disarms the Electrical Ground Fault Protection System: locomotive computer forces engine speed to remain at idle when ground relay is cut out, and prevents main generator loading.

This switch is normally locked in the closed (lever up) position by a pin which is safety wired to a switch guard bracket to discourage inadvertent use by other than authorized maintenance personnel. In this position, the Ground Fault Protection System is armed.

LIGHTS Circuit Breaker

This breaker must be **ON** (lever up) to supply power to the switches that control miscellaneous locomotive lights.

HDLTS. (Headlights) Circuit Breaker

This breaker must be **ON** (lever up) to supply power for the headlights through the **HDLTS. FRONT** and **HDLTS. REAR** control switches on the Operator's Control Stand, and to the remote **HEADLIGHT CONTROL** switch on the Engine Control Panel.

FRONT DITCH LIGHTS Circuit Breaker

This breaker must be **ON** (lever up) to supply power for the front ditch lights through contacts of the **HDLTS. FRONT** control switch on the Control Stand.

REAR DITCH LIGHTS Circuit Breaker

This breaker must be **ON** (lever up) to supply power for the rear ditch lights through contacts of the **HDLTS. REAR** control switch on the Control Stand.

DRAIN HEATER Circuit Breaker

This breaker must be **ON** (lever up) to provide power and protection to the main reservoir and main reservoir filter automatic drain valve heaters and associated circuitry. (These drain valves are designated MV-818, MV-824, MV-880-1 and MV-880-2.)

REFRIGERATOR Circuit Breaker

This breaker must be **ON** (lever up) to supply power and protection to the refrigerator unit.

AUTO DRAIN TIMER CYCLE Circuit Breaker

This breaker must be **ON** (lever up) to provide power and protection to the main reservoir and main reservoir filter automatic drain valves and associated circuitry, including a portion of the Electric Blowdown Timer EBT circuit. (These drain valves are designated MV-818, MV-824, MV-880-1 and MV-880-2.)

Circuit breakers and switches in the black labeled section (those that must be ON during locomotive operation) will include:

SP IND. / ER CONT. Circuit Breaker

This breaker must be **ON** (lever up) to provide power and protection to the following:

- Speed Indicator System
- Events Recorder/Train Monitoring System

AUTO WATER DRAIN Circuit Breaker

This breaker protects the automatic cooling system drain circuit. It must be **ON** (lever up) to enable arming the circuit (refer to, "AUTO. DRAIN COLD WATER FILL Switch" on page 2-67') and must then remain **ON** continuously in order for the system to protect against freezing.

GEN (Generator) TRANSITION Circuit Breaker

This breaker protects the main coil of the main generator series contactor (SGC), and a portion of its control circuitry. It must be **ON** (lever up) to enable forward (parallel-to-series) main generator transition, for high speed operation.

FUEL PUMP Circuit Breaker

This breaker must be **ON** (lever up) to provide power and protection to the AC engine fuel pump motor and inverter circuitry. A fuel filter bypass valve (with gauge) is provided to prevent overloading fuel pump motor if fuel filters become clogged. This breaker may also be used in an emergency to stop the engine by fuel starvation, but use for this purpose is not recommended.

AC EQUIPMENT Circuit Breaker

This breaker must be **ON** (lever up) to protect the control system equipment that operates on AC power from the companion alternator; including portions of ground relay circuit, and main generator field. If breaker trips OFF during locomotive operation, the main generator will not develop power and the locomotive computer will display the **NO LOAD - NO COMPANION ALTERNATOR OUTPUT** message (companion alternator supplies main generator excitation current).

CONTROL Circuit Breaker

This breaker must be **ON** (lever up) to set up the fuel pump and control circuits for engine starting. It is supplied battery power through the battery knife switch before an engine start. Once the engine is running, the auxiliary generator supplies power through this breaker to maintain operating control.

TURBO LUBE Circuit Breaker

This breaker must be **ON** (lever up) to start engine and operate turbocharger auxiliary lube oil pump. It must remain **ON** to provide auxiliary lubrication to turbocharger at engine start and after engine shutdown.
A safety guard is used over this breaker to discourage inadvertent actuations.

CAUTION

Do **NOT** open the **TURBO LUBE** breaker or the **COMPUTER CONTROL** breaker at engine shutdown following load operation. The **TURBO LUBE** breaker, in conjunction with **COMPUTER CONTROL** breaker, allows the turbocharger auxiliary lube oil pump to operate and cool the turbocharger for approximately 35 minutes following engine shutdown.

COMPUTER CONTROL Circuit Breaker

This breaker must be **ON** (lever up) to protect the circuit that supplies operating power to the locomotive computer system and to the radar transceiver.

CAUTION

When cycling any circuit breaker on this panel, open **COMPUTER CONTROL** breaker first and close **COMPUTER CONTROL** breaker last. Turbo lube pump will <u>not</u> run with **COMPUTER CONTROL** breaker **OFF**.

ENGINE CONTROL Circuit Breaker

This breaker must be **ON** (lever up) to supply power and protection to the EMDEC system 74 to 24 VDC converter.

BRAKE TRANS. (Transfer) CONTROL Circuit Breaker

Contacts of this breaker are located in the feed to the operating motor of the switchgear that controls traction motor field and armature connections for dynamic braking and power operation.

Since power is required to move transfer switchgear from one position to another, this breaker must be **ON** (lever up) to enable transfer from motoring to dynamic braking, or vice-versa.

An open breaker does not prevent switchgear that is already in position from conducting traction motor current, but interlocking prevents an operating setup in conflict with transfer switch position.

REV. (Reverser) CONTROL Circuit Breaker

Contacts of this breaker are located in the feed to the operating motor of the switchgear that controls the direction of current flow through the traction motor fields and, therefore, the direction of locomotive travel. Since power is required to move the RV transfer switchgear from one position to another, this breaker must be **ON** (lever up) to enable transfer from forward operation to reverse, or vice-versa.

An open breaker does not prevent switchgear that is already in position from conducting traction motor current, but interlocking prevents an operating setup in conflict with RV transfer switch position.

LOCAL CONTROL Circuit Breaker

This breaker must be **ON** (lever up) to protect circuits that supply operating power from the auxiliary generator to "local" (not trainline-controlled) circuits for operation of heavy duty switchgear and various control devices.

AUX. GEN. (Auxiliary Generator) FEEDBACK Circuit Breaker

This breaker must be **ON** (lever up) to conduct auxiliary generator AC power to a portion of the locomotive computer, and to protect against certain types of malfunctions.

AUX. GEN. (Auxiliary Generator) FIELD Circuit Breaker

This breaker must be **ON** (lever up) to protect the voltage regulator and auxiliary generator field circuit. If this breaker trips **OFF**, auxiliary generator output stops. The computer will display the **NO LOADING - NO AUX GEN OUTPUT** message in approximately two (2) seconds after the breaker trips open, if the diesel engine is running.

NO. 2 CIRCUIT BREAKER PANEL

The No. 2 Circuit Breaker Panel, also known as the "Circuit Breaker and Test Panel Compartment," Figure 2-20. , on page 2-60, has provisions for circuit breakers as well as a sealed section that contains a test panel which is intended for use by maintenance personnel only during maintenance and test procedures. A 74 VDC receptacle and a fuse test toggle switch are also part of this panel.

The circuit breaker portion of the panel is divided into sections. The breakers above the ***shaded*** (dark) end sections of the nameplate must be **ON** (lever up) during locomotive operation. The breaker above the ***unshaded*** (light) center section of the nameplate is used as required.

GEN. (Generator) FIELD Circuit Breaker

This breaker must be **ON** (lever UP) to enable locomotive operation. It protects the main generator excitation circuit, which includes the companion alternator, the SCR assembly, and the main generator field windings. (Also see note on page 2-61 about resetting this breaker.)

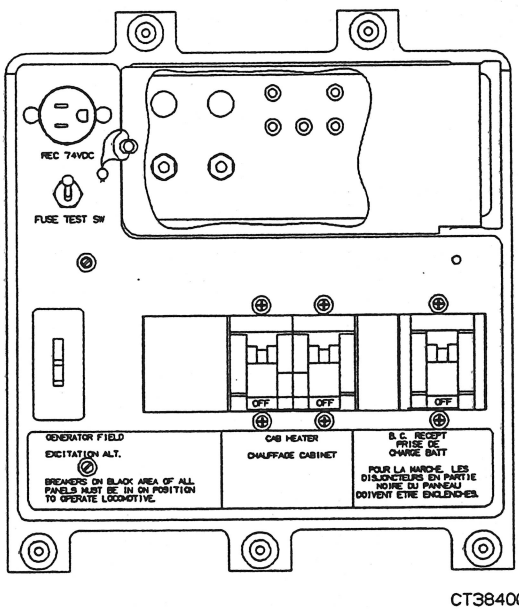


Figure 2-20. Typical No. 2 Circuit Breaker Panel

CAB HEATER Breaker

This heavy duty breaker must be **ON** (lever up) to provide power and protection for the components of the central cab heating system, including; the heating elements, the AC inverter, and the unit's fan motor and control circuitry.

B. C. RECEPT (Battery charging Receptacle) Circuit Breaker

This breaker is located in the circuit between the externally mounted (below the underframe on right side of the locomotive) battery charging plug-in receptacle and the locomotive batteries. The breaker is used to protect the wiring on board the unit and must be **ON** (lever UP) to enable charging the batteries through the receptacle. (Also see note below about resetting this breaker.)

NOTE

Unlike most other breakers on the panel that trip to the full **OFF** position, the Battery Charging and Generator Field circuit breakers trip to the center position. To reset these breakers, wait for the breaker to cool, pull the lever down to the full **OFF** position, then raise it to the **ON** position.

FUSE TEST Toggle Switch

Refer to, "FUSE TEST EQUIPMENT" on page 2-63 in the Fuse And Switch Panel section for information about the use of this switch.

74 VOLT Receptacle

This receptacle provides 74 volt DC power (64 VDC if locomotive is not running & set up for power), for maintenance and testing provided that the battery knife switch and the **LIGHTS** circuit breaker are both closed.

FUSE AND SWITCH PANEL

The fuse and switch panel, also known as the "Fuse and Switch Compartment," Figure 2-21. , on page 2-62, contains the equipment described in the following paragraphs.

AUX. GEN. (Auxiliary Generator) Circuit Breaker

NOTE

There is no companion alternator field fuse. If a fault occurs in this circuit, the **NO LOAD - NO COMPANION ALTERNATOR OUTPUT** message will appear on the computer display, and the alarm bell will ring.

This breaker must be **ON** (lever UP) to supply power from the auxiliary generator to the 74 volt DC system and to protect against excessive current demands. The 74 volt DC system provides excitation to the companion alternator. Therefore, if breaker trips open or is manually opened, the **NO LOAD - NO COMPANION ALTERNATOR OUTPUT** message will appear on the Computer Display, and the alarm will ring.

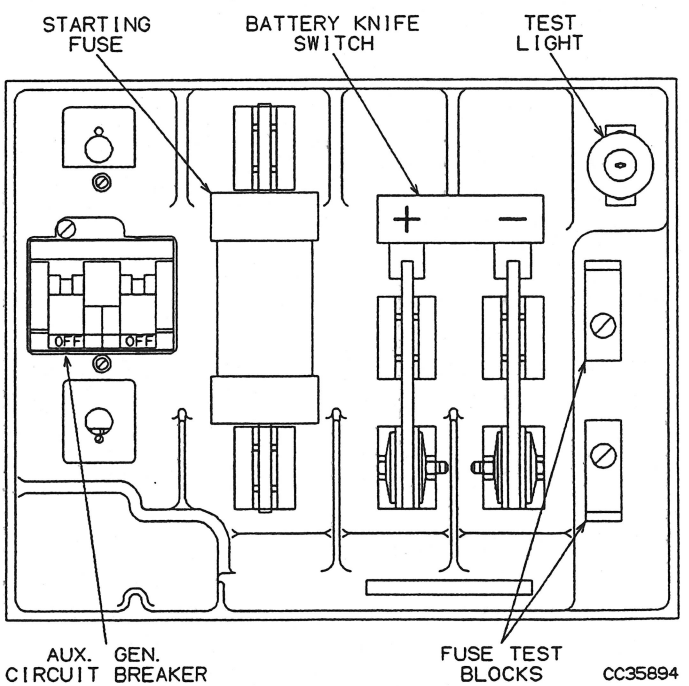


Figure 2-21. Typical Fuse And Switch Panel

STARTING Fuse

The starting fuse is in use only when the diesel engine is being cranked. At that time, battery current flows through the fuse and the starting contactor to the starting motors.

Although the fuse should be in good condition and always left in place, it has no effect on locomotive operation other than for engine starting.

A defective starting fuse may be detected if starting motors will not crank engine when required, even though the battery knife switch is closed, engine start switch is operated, and starting contactors pick up. To check fuse condition. Refer to "FUSE TEST EQUIPMENT" below.

CAUTION

This locomotive is equipped with a 400 Ampere starting fuse. Similar units, with different starting motor connections, may have an 800 ampere starting fuse. The two fuses look identical, except for their markings. **Do not use a fuse rated higher than 400 Amperes for starting this locomotive.**

BATT SW (Battery Knife Switch)

When closed, battery knife switch connects locomotive batteries to the locomotive low voltage (64/74 VDC) electrical system. **This switch should be closed at all times during locomotive operation.**

FUSE TEST EQUIPMENT

A pair of fuse test blocks and a test light are installed in the right side of the Fuse and Switch Panel compartment. A test light toggle switch is located on the upper left portion of the No. 2 Circuit Breaker Panel compartment, immediately to the left of the sealed Test Panel. Fuses may be tested as follows:

1. Move test light toggle switch lever to the **ON** position. Fuse test light should turn **ON**.

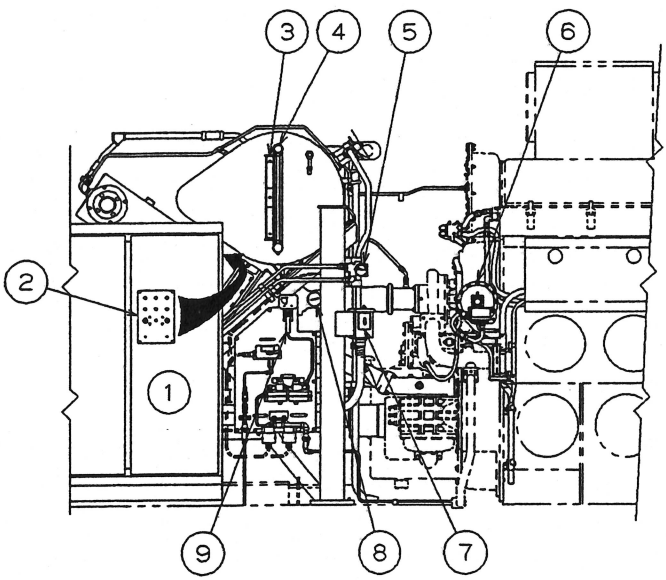
2. Move test light toggle switch lever to the **OFF** position. Fuse test light should turn **OFF**.

3. Place fuse to be tested across test blocks so that metal ends of fuse are in firm contact with the blocks. (Test light will turn **ON** if fuse is good.)

It is always advisable to test fuses before installing them. Always electrically isolate suspect circuits before changing or replacing fuses.

ENGINEROOM EQUIPMENT

Engine starting and monitoring equipment, along with the EMDEC engine control annunciator (fault) panel, are located in the engineroom at the No. 3 AC Electrical Cabinet and on the equipment rack at the front of the engine, as shown on Figure 2-22.



1- AC ELECTRICAL CABINET
2- ANNUNCIATOR (FAULT) PANEL
3- WATER LEVEL INSTRUCTION PLATE
4- WATER LEVEL SIGHT GLASS
5- FUEL FILTER BYPASS GAUGE
6- CRANKCASE PRESSURE DETECTOR
7- FUEL PRIME/ENGINE START SWITCH (FP/ES)
8- WATER TEMPERATURE GAUGE
9- MANUAL SHUTTER CONTROL VALVE

CT38401

Figure 2-22. Typical Engineroom Equipment

ENGINE STARTING CONTROLS

Note: Refer to OPERATION Section 3 of this manual for engineroom inspection and engine starting instructions.

FUEL PRIME/ ENGINE START (FP/ES) Switch

This three-position rotary switch is located on a starting controls junction box mounted on the equipment rack, Figure 2-23, page 2-67. The three switch positions are:

FUEL PRIME Position

This position is used to prime the engine with fuel prior to starting. The fuel pump motor circuit is energized with battery power, but not the starting circuit. In addition, the auxiliary turbocharger lube oil pump motor is energized, ensuring a supply of lube oil under pressure to the turbocharger bearings during startup.

ENGINE START Position

This position applies battery power to the fuel pump circuit and the starting motors. The starting motor pinion gears engage the engine ring gear, and the starters crank the engine until **FP/ES** switch is released.

CENTERED (OFF) position

The **FP/ES** switch is spring-loaded to return to this position when released.

> **NOTE**
>
> The Fuel Prime/ Engine Start Switch is equipped with a hook to hold the **DO NOT START ENGINE/LEAVE THIS ENGINE ISOLATED** tag over the switch. A similar hook is provided on the Engine Control Panel.

Note: A "red" indicator light on top of the **FP/ES** switch junction box will turn **ON** if starting motors have been overloaded. If light comes **ON**, computer drops out starting motors and will not re-energize them for two (2) minutes after the light goes **OFF**. Computer will display the **NO START - STARTER MOTOR OVERLOAD** message during the two-minute period.

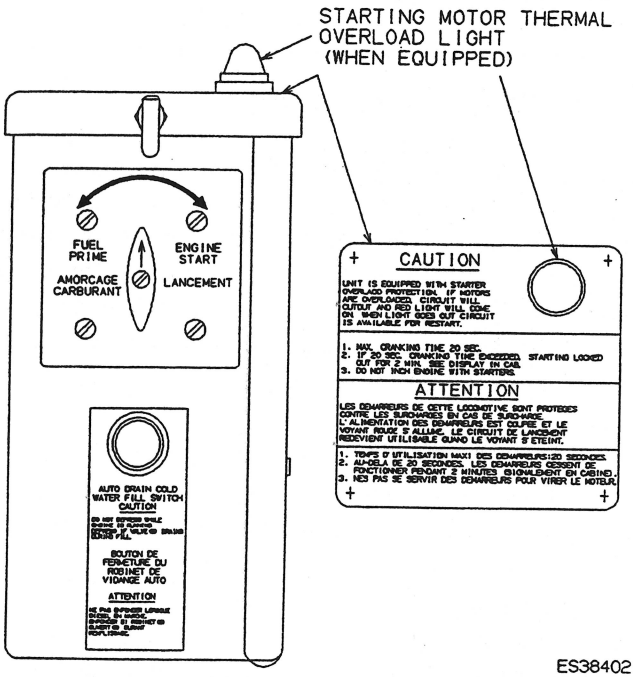


Figure 2-23. Fuel Prime/ Engine Start (FP/ES) Switch

AUTO. DRAIN COLD WATER FILL Switch

Operating this push-button switch, located below the **FP/ES** switch on the starting controls junction box, Figure 2-23, disarms the automatic cooling system drain circuit. If the automatic drain valve is open, operating the switch causes the valve to close, allowing the cooling system to be refilled.

CAUTION

The automatic cooling system drain circuit remains disarmed and, therefore, will not protect the cooling system against freezing after the cold water fill push-button switch is operated until the **FP/ES** switch is turned to the **ENGINE START** position.

Do NOT depress the Auto. Drain Cold Water Fill Switch while the engine is running. Depress if valve drains during fill.

ANNUNCIATOR (Fault) PANEL

The annunciator (fault) panel, Figure 2-24, page 2-69, is located on the side of the No. 3 AC Electrical Cabinet. It is the "center" of the **EMDEC** Engine Protection and Diagnostics system in the locomotive engineroom. It contains the LED indicating lights and switches available to the operating (or maintenance) crew to control the EMDEC system operation and diagnostic functions.

FAULT INDICATING LIGHTS

The fault indicating lights are used to determine if a specific fault condition has caused an engine protection shutdown.

CAUTION

Following an engine shutdown, no attempt should be made to restart the engine until the cause of the shutdown has been determined and action taken to correct the fault condition.

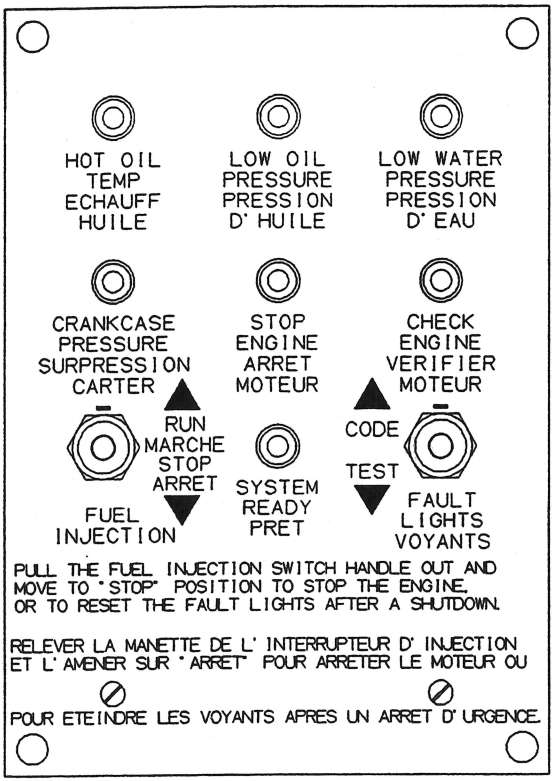

HOT OIL TEMP ECHAUFF HUILE
LOW OIL PRESSURE PRESSION D' HUILE
LOW WATER PRESSURE PRESSION D' EAU
CRANKCASE PRESSURE SURPRESSION CARTER
STOP ENGINE ARRET MOTEUR
CHECK ENGINE VERIFIER MOTEUR
RUN MARCHE
STOP ARRET
FUEL INJECTION
SYSTEM READY PRET
CODE
TEST
FAULT LIGHTS VOYANTS
PULL THE FUEL INJECTION SWITCH HANDLE OUT AND MOVE TO "STOP" POSITION TO STOP THE ENGINE, OR TO RESET THE FAULT LIGHTS AFTER A SHUTDOWN.
RELEVER LA MANETTE DE L' INTERRUPTEUR D' INJECTION ET L' AMENER SUR "ARRET" POUR ARRETER LE MOTEUR OU
POUR ETEINDRE LES VOYANTS APRES UN ARRET D' URGENCE.
EN38403

Figure 2-24. Typical Annunciator (Fault) Panel.

HOT OIL TEMP Light

The "red" hot oil temperature light will come **ON** to indicate that a high engine oil temperature condition has caused an engine shutdown. The EMDEC Engine Protection system determines this fault when engine oil temperature exceeds a specified trip level for a minimum of 10 seconds.

LOW OIL PRESSURE Light

The "red" low oil pressure light will come **ON** to indicate that engine lube oil pressure has dropped to a danger-

ously low level and caused an engine shutdown. The Engine Protection system determines this fault when engine oil pressure remains below the specified trip level after a time delay which will vary according to engine speed.

LOW WATER PRESSURE Light

The "red" low water pressure light will come **ON** to indicate that a low water flow condition has caused an engine shutdown. The Engine Protection system determines this fault when the difference in pressures between sensing points in the engine cooling system is greater than a specified value after a time delay relative to engine speed.

CRANKCASE PRESSURE Light

The "red" crankcase pressure light will come **ON** to indicate that a positive crankcase pressure condition has caused an engine shutdown. This fault is determined when crankcase pressure increases to a specified positive trip level. In addition to the fault light, a protruding button on the crankcase pressure detector indicates the device has tripped and caused the engine to shut down.

WARNING

Following an engine shutdown caused by actuation of the crankcase pressure detector, make no further engineroom inspections until engine has been allowed to cool off for at least two hours. ***The action of the pressure detector indicates the possibility of a condition within the engine that could ignite hot oil vapors with an explosive force.*** Do **NOT** attempt to restart the engine until the cause of the detector trip has been determined and corrected.

When activated, the detector must be manually reset by pushing in the reset button. If button cannot be reset, do **NOT** operate engine until pressure detector has been replaced as it may have internal damage.

NOTE

When the engine is shut down by the EMDEC engine protection system, the actual fault condition is automatically reset in the ECM. To reset the annunciator function of the system, it is necessary to pull outward on the handle of the **FUEL INJECTION** switch, placing it in the ***STOP*** (down) position. When switch handle is returned to the ***RUN*** (up) position, the fault light indicating cause of shutdown should go **OFF**. The system ready light will remain **ON** when the engine has been shut down by the EMDEC engine protection system.

If freezing temperatures are possible during the shutdown, the cooling system and the flush toilet (if provided) should be drained or otherwise protected from freezing.

ENGINE DIAGNOSTIC LIGHTS

The engine diagnostic lights provide the means to access the EMDEC Self Diagnostic system. The system continuously monitors itself and other system components including sensors, injectors, connectors, and associated wiring. If a fault is detected during locomotive operation, one or both of the diagnostic lights will be illuminated depending on the severity of the fault. Any faults that occur are stored as codes in the system ECM memory. The stored codes may be accessed by placing the **FAULT LIGHTS** switch on the panel in the ***CODE*** position (up) and observing the "flashing" displayed on one or both of the diagnostic lights, provided that power is being supplied to the EMDEC system (with the engine at idle or shutdown) and the engine is not in a protection condition.

STOP ENGINE LIGHT (SEL)

The "red" stop engine light (SEL) will come **ON** to indicate that a potential engine damaging condition has been detected. If the system is programmed to shut down for

this condition, the engine will shut down automatically and a corresponding fault indicating light on the annunciator panel will come **ON**.

This light is also used to "flash out" the *active* fault codes using the **FAULT LIGHTS** switch on the annunciator panel. An *active* code is a fault that is currently keeping one or both of the diagnostic lights **ON**, as well as a corresponding fault light. *Active* codes are displayed (flashed) in order from the "most recent" to the "least recent" based on engine running hours. *Active* codes are immediately stored in the ECM memory as *inactive* codes when they occur.

NOTE

The stop engine light (SEL) should also come **ON** when the **FAULT LIGHTS** switch is placed in the ***TEST*** (down) position, with power applied to the EMDEC system, as a test of the light and system circuit.

CHECK ENGINE LIGHT (CEL)

The "yellow" check engine light (CEL) will come **ON** to indicate that a fault has occurred and lasted at least 2 seconds in duration. If the fault goes away, the light will go out, but a fault code will be stored in the ECM memory as an *inactive* code. The condition should be diagnosed at the next unit service or maintenance check point.

This light is also used to "flash out" the *inactive* fault codes using the **FAULT LIGHTS** switch on the annunciator panel. All *inactive* codes are faults that previously occurred. *Inactive* codes are displayed (flashed) in order from the "most recent" to the "least recent" based on engine running hours.

NOTE

The check engine light (CEL) should also come **ON** when the **FAULT LIGHTS** switch is in the ***TEST*** (down) position, with power applied to the EMDEC system, as a test of the light and system circuit.

FUEL INJECTION SWITCH

This device is a two position latching toggle switch. It must be pulled outward and up to be placed in the ***RUN*** position in order to start and operate the diesel engine (enable fuel injection). The engine will shut down whenever this switch is pulled outward and down into the ***STOP*** position (disable fuel injection). The ***STOP*** position is also used to reset the EMDEC engine protection system after a shutdown. The fault indicating lights should go **OFF** and stay off when the switch is returned to the ***RUN*** position.

NOTE

This switch provides the only means to stop the diesel engine from within the engineroom.

NOTE

Placing the **FUEL INJECTION** switch in the ***STOP*** position also allows engine to be cranked without firing the cylinders.

SYSTEM READY LIGHT

The "green" LED system ready light will be **ON** whenever power is being supplied to the EMDEC system (fuel pump circuit energized) and the **FUEL INJECTION** switch is set in the ***RUN*** position. This light will remain **ON** if the engine is in an EMDEC protection (shutdown) condition.

This light will not be **ON,** if the engine has been shut down using the ***STOP*** position of the **FUEL INJECTION** switch, an Emergency Fuel Cut-Off (EFCO) switch, or the throttle handle **STOP** position, and the engine shutdown circuit has not been reset.

NOTE

Shutdown circuit is reset by momentarily placing the Fuel Prime/Engine Start switch in either the **FUEL PRIME** or **ENGINE START** position.

FAULT LIGHTS SWITCH

This device is a toggle type switch with two momentary contact positions; ***CODE*** (up) and ***TEST*** (down), and a spring return to the center (release) position. ***This switch may also be referred to as a Diagnostic Request switch.***

Placing the switch in the ***CODE*** (up) position activates the EMDEC Self Diagnostic "flash code" system. This can be done any time power is being supplied to the EMDEC system (with the engine at idle or shutdown), provided that the engine is not in a protection condition. *Active* codes will be flashed on the stop engine light (SEL) first, followed by *inactive* codes on the check engine light (CEL).

To deactivate the EMDEC "flash code" system, cycle the **FAULTS LIGHTS** switch to the ***TEST*** position and release. With this switch in the ***TEST*** position, all of the indicating lights on the panel should come **ON,** and then reset to **OFF** when switch is released. If any light fails to come **ON,** the annunciator panel needs to be replaced.

To clear a fault indication from the annunciator panel, the **FUEL INJECTION** switch must be placed momentarily in the ***STOP*** position, and then returned to the ***RUN*** position to enable an engine restart. The fault light should go **OFF** and the **SYSTEM READY** light should be **ON.**

NOTE

Correcting the condition that caused the fault code and resetting the annunciator function does NOT clear the code from the ECM memory. Actual clearing of codes can only be done by authorized maintenance personnel using a PC computer with a special diagnostics program.

NOTICE:

Since the Self Diagnostics of the EMDEC system do not detect all possible faults, the absence of a fault code does not mean there are no problems in the system. If an EMDEC system problem is suspected, even in the absence of a code, report the situation to proper maintenance personnel for further investigation.

MONITORING DEVICES

A number of devices are provided in the engineroom, and shown in Figure 2-23, page 2-67, which allow the operator to visually monitor the condition of various systems.

Each device represents a system which could be a cause of an engine shutdown. Periodic checks of these devices will alert the operator to potential problems or failures. ALL abnormal readings from these devices should also be reported to the proper maintenance personnel.

WATER LEVEL Sight Glass & Instruction Plate

An instruction plate is mounted next to the sight gauge on the water tank. To check water level, open round valve handle at the bottom of the gauge. Read water level using the instruction plate as a gauge, then close valve. To avoid a false reading when the gauge is used the next time, drain the sight glass by means of small drain cock at the bottom of the gauge. Be sure to close drain cock after draining.

WATER TEMPERATURE Gauge

This gauge indicates water temperature at engine cooling water inlet. The gauge is color coded to indicate **COLD** (blue), **NORMAL** (green), and **HOT** (red). Gauge readings approaching the red zone may occur when locomotive is operating in a tunnel.

LUBE OIL PRESSURE GAUGE

This gauge provides a ready reference indication of engine lube oil pressure. During normal operation, lube oil pressure will increase as diesel engine speed increases.

FILTER BYPASS Gauge

This gauge indicates the condition of the primary fuel filter. A high gauge reading indicates increased pressure differential across the filter. As the pressure increases, a bypass valve begins to open, bypassing the primary fuel filter. This bypassing condition imposes greater filtering burden on the engine mounted fuel filters, which will shorten their service life.

ENGINE OVERSPEED CONTROL

Engine overspeed control with the EMDEC system is a function of the Electronic Control Module ECM control logic which limits engine speed to a pre-programmed maximum. Any condition which could lead to an engine overspeed will cause the EMDEC system to reduce the fuel metering to the injectors to maintain the maximum preset engine speed. EMDEC will <u>not</u> shut down the engine during such a condition unless another *protected* fault is detected.

MISCELLANEOUS DEVICES

MANUAL SHUTTER CONTROL Valve

The locomotive computer closes/ opens the air-operated engine cooling system radiator shutters by energizing/ de-energizing a solenoid valve that pressurizes/ exhausts air from the shutter operating cylinders.

Figure 2-22, page 2-65, illustrates the location of the manual shutter control valve. During normal operation, this valve is set in the **OPERATION** position, which enables the computer to close the shutters by energizing the solenoid valve.

The shutters may be opened manually by moving the shutter control valve to the **TEST** position which will cut off and exhaust the air supplied by the solenoid valve, enabling spring pressure to open the shutters.

Section 3. OPERATION

INTRODUCTION

This section provides recommended procedures for operation of the locomotive. The procedures are briefly outlined and do not contain detailed explanation of equipment location or function. To locate a procedure in this section, refer to the Table Of Contents near the front of the manual.

PREPARATION FOR SERVICE

GROUND INSPECTION

Check for the following:

- Leakage of fuel oil, lube oil, water, or air.
- Loose or dragging parts.
- Proper air brake hose connections between units in multiple (consist), and to train.
- Proper installation of electrical control cables between units in multiple (consist), and to train.
- Proper positioning of all angle cocks and shut-off valves.
- Air cut in to truck brake cylinders.
- Satisfactory condition of brake shoes.
- Adequate fuel supply.

4. Battery charging cable removed and main battery knife switch closed.

LEAD UNIT CAB INSPECTION

On the lead or control unit, the control locations described in Section 2 should be checked and the equipment positioned for operation as follows:

FUSE AND SWITCH PANEL

1. Main Battery Knife switch closed.
2. Starting Fuse installed and in good condition, and of the correct rating (as indicated in compartment).
3. Aux. Gen. Circuit Breaker in **ON** (up) position.

CIRCUIT BREAKER PANELS

1. All breakers in the shaded (black labeled) areas of panels in the **ON** (up) position.
2. Other circuit breakers **ON** (up), as required.
3. At the No. 1 Circuit Breaker Panel; verify that the Ground Relay Cutout switch is closed.

ENGINE CONTROL PANEL

1. Verify that no "**DO NOT START ENGINE**" tag is hanging over Isolation switch, then place switch in the **START/STOP/ISOLATE** position.
2. Headlight Control switch in proper position for lead unit operation.
3. Dynamic Brake Cutout switch set in the **ON (Cut In)** position.
4. Miscellaneous switches and circuit breakers positioned as required

NOTE

The No. 1 Electrical Control Cabinet is pressurized with filtered air. Cabinet doors must be securely closed during locomotive operation.

OPERATOR'S CONTROL STAND

Switches and operating handles on the Control Stand should be positioned as follows:

1. Place Fuel Pump & Control switch in **ON** (up) position.
2. Place the Engine Run switch and the Generator Field switch in the **OFF** (down) position.
3. Light and miscellaneous switches positioned as desired.
4. Move Throttle handle to **IDLE** and dynamic brake handle to **OFF** position. Set Directional (Reverser) handle in **NEUTRAL** (centered) position.

AIR BRAKE EQUIPMENT

1. Set the Automatic Brake Valve handle in **SUP (suppression)** position. This will nullify the application of any safety control (TMS/ Vigilance) equipment used.
2. Move Independent Brake Valve handle to **APP (full application)** position.
3. Set Cut-Off Pilot Valve to either **FRT** or **PASS** position, depending on make-up of train.
4. Set Multiple Unit **(MU-2A)** Valve on page 2-19 in the **LEAD OR DEAD** position, as indicated at the valve handle.

STARTING THE DIESEL ENGINE

After the following inspections have been completed, diesel engine may be started.

ENGINEROOM INSPECTION

The engineroom equipment can be inspected and operated by opening access doors along the sides of the locomotive long hood.

1. Check air compressor for proper lube oil supply.
2. Check that water level, in Water Tank Sight Glass, is near the **FULL (ENGINE DEAD)** mark on the Water Level Instruction Plate.

> **NOTE**
> Water level should be rechecked when engine is running. Level should be near **FULL (ENGINE RUNNING)** mark.

3. Check all valves for proper positioning.
4. Observe for leakage of fuel oil, lube oil, water, or air.

ENGINE INSPECTION

Inspect engine before starting, as well as afterward.

1. Check the Crankcase (oil pan) Pressure Detector reset button to be certain it is set (pressed in). If button protrudes, press and hold it in for five (5) seconds immediately after engine starts.
2. Check engine top deck, air box, and oil pan inspection covers, making sure they are in place and are securely closed.
3. Check Sight Gauge on lube oil filter tank. If gauge is full, proceed to step 4. If gauge is empty, make certain that oil strainer housing is full. The oil level should be maintained at the level of the housing overflow outlet.
4. Pull out Oil Level Gauge (dipstick) from either side of the engine oil pan. Oil gauge should be coated with oil.

NOTE

A properly filled lube oil system will coat the oil gauge above the **FULL** mark when the engine is stopped. To obtain an accurate check, recheck level when the engine is idling and at normal operating temperature.

ENGINE STARTING

After the preceding inspections have been completed, the diesel engine may be started. Close engineroom doors after engine starts.

To start engine, proceed as follows:

NOTE

If engine water temperature is 10°C (50°F) or less, preheat engine before attempting to start. Prelube engine if it has been shut down for more than 48 hours. Refer to Engine Maintenance Manual for prelube instructions.

1. At the Annunciator (Fault) Panel on the side of the No. 3 AC electrical cabinet, place the **FUEL INJECTION** switch in the ***STOP*** (down) position. Open cylinder test valves and bar over the engine at least one revolution. Check for leakage of fluids from test valves and notify maintenance personnel if any is observed.

   NOTE

   Placing the **FUEL INJECTION** switch in the ***STOP*** position allows engine to be cranked without firing cylinders, even if fuel system has been primed.

2. Close cylinder test valves and return the **FUEL INJECTION** switch to the ***RUN*** (up) position.

NOTE

The "green" **SYSTEM READY** light on the Annunciator Panel must be **ON** to enable an engine start. Light should go **ON** when the Fuel Prime/Engine Start (**FP/ES**) switch is placed in the **FUEL PRIME** position, as in step 5 following. Operating this switch will energize the fuel pump circuit and reset the engine shutdown circuit.

3. At the Operator's Control Stand, make certain that only the Fuel Pump & Control switch is **ON** (up). The Engine Run and Generator Field switches should be **OFF** (down).

NOTE

When starting a trailing unit diesel engine, and control cables have been connected between units, the trailing unit's Fuel Pump & Control switch should remain **OFF** (down).

4. At the No. 1 Electrical Control Cabinet, check status of the starting fuse, and that the Main Battery Knife switch, Ground Relay Cutout switch and the Aux. Gen. Circuit Breaker are all closed. Also, make sure that all breakers in the shaded (black labeled) areas on the Circuit Breaker Panel(s) are in the **ON** (up) position. In addition, verify that the Isolation Switch on the Engine Control Panel is in the **START/STOP/ISOLATE** position.

5. At the starting controls junction box on the equipment rack, verify that no "**DO NOT START ENGINE**" tag is hanging over the Fuel Prime/Engine Start (**FP/ES**) switch, then set switch in the **FUEL PRIME** position until fuel flows in the return fuel sight glass, Figure 3-1. on page 3-8, to indicate that the EUI (injection) system is charged with fuel.

NOTE

The EUI (injection) system requires a fuel supply pressure greater than that used with mechanical injectors and, therefore, usually takes a longer period of time to fill the injectors with the fuel prime charge.

Also, fuel flow observed in the return fuel sight glass WILL contain air bubbles (fuel turbulence) during engine prime and normal operation. Operator's are advised to **IGNORE BUBBLES IN THE RETURN FUEL SIGHT GLASS** on units equipped with the EUI (injection) system.

6. Move the Fuel Prime/Engine Start (**FP/ES**) switch to **ENGINE START** position and hold in this position until the engine fires and speed increases, but **NOT** for more than twenty (20) seconds.

CAUTION

EMDEC equipped engines may require a slightly longer cranking time than mechanically governed engines. Therefore, it is important to observe the recommended 20 second time limit for holding the starting motors engaged in order to avoid a thermal overload condition.

Do **NOT** advance throttle to increase engine speed above IDLE until oil pressure is confirmed.

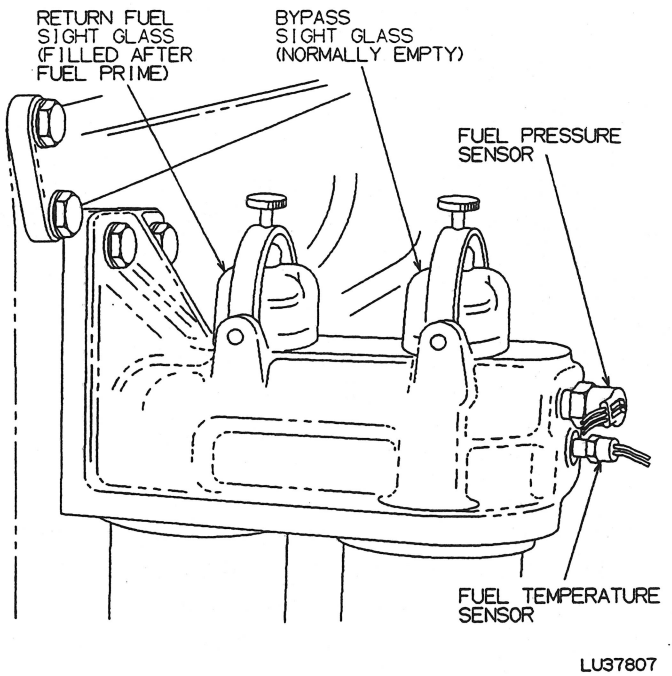


Figure 3-1. Fuel Oil Sight Glasses

NOTE

All EMDEC engine protection sensors are ignored for the first 60 seconds after an engine start. If a fault is detected after the 60 second period times out, then a fault light will come ON and EMDEC will automatically shut down the engine.

Engine water inlet temperature should be allowed to reach 49°C (120°F) at idle before load is applied.

7. Check the following with the engine running and at normal operating temperature.
   - Coolant level should be near the **FULL (ENGINE RUNNING)** mark on the Water Level Instruction Plate.
   - Lube oil level should be near the **FULL** mark on the Oil Level Gauge (dipstick).
   - Compressor lube oil level.

TRAILING UNIT CAB INSPECTION

Switches, circuit breakers, and controls located in the cab of a trailing unit should be checked for proper positioning as follows:

FUSE AND SWITCH PANEL

1. Main Battery Knife switch closed.
2. Starting Fuse installed and in good condition, and of the correct rating (as indicated in compartment).
3. Aux. Gen. Circuit Breaker in **ON** (up) position.

CIRCUIT BREAKER PANELS

1. All breakers in the shaded (black labeled) areas of panels in the **ON** (up) position.
2. Other circuit breakers **ON** (up), as required.
3. At the No. 1 Circuit Breaker Panel; verify that the Ground Relay Cutout switch is closed.

ENGINE CONTROL PANEL

1. Isolation switch in the **START/STOP/ISOLATE** position (no "**DO NOT START ENGINE**" tag over switch).
2. Headlight Control switch in proper position to correspond with unit position in a consist.

3. Dynamic Brake Cutout switch set in the **ON (Cut In)** position.

4. Miscellaneous switches and circuit breakers positioned as required.

NOTE

The No. 1 Electrical Control Cabinet is pressurized with filtered air. Cabinet doors must be securely closed during locomotive operation.

OPERATOR'S CONTROL STAND

Switches and operating handles on the Control Stand should be positioned as follows:

1. The Fuel Pump & Control switch, Engine Run switch and the Generator Field switch must all be in the **OFF** (down) position.

2. Light and miscellaneous switches positioned as desired.

3. Move Throttle handle to **IDLE** and dynamic brake handle to **OFF** position. Set Directional (Reverser) handle in **NEUTRAL** (centered) position and remove it.

AIR BRAKE EQUIPMENT

1. Place the Automatic Brake Valve handle in **H O (HANDLE OFF)** position.

2. Move Independent Brake Valve handle to **REL (RELEASE)** position.

3. Set Cut-Off Pilot Valve to the **OUT** position.

4. Set Multiple Unit **(MU-2A)** Valve on page 2-19 in the **TRAIL** position, as indicated at the valve handle.

STARTING TRAILING UNIT DIESEL ENGINES

Engines in trailing units are started in the same manner as the engine in the lead unit. Refer to "ENGINE STARTING," page 3-5.

NOTE

If control jumper cables are already connected between units, make sure that the Fuel Pump & Control, Generator Field, and Engine Run switches are **OFF** (down). This will allow these systems to be controlled from lead unit.

PLACING UNITS ON LINE

After the diesel engine is started and inspected, unit may be placed "on-line" by setting the Isolation Switch in the **RUN** position.

NOTE

If the units coupled in the consist are at a standstill, be certain that Throttle handle in each unit is in the **IDLE** position before switching any unit *on-line*.

PRECAUTIONS BEFORE MOVING LOCOMOTIVE

The following points should be carefully checked before attempting to move the locomotive under its own power:

1. Make sure that main reservoir air pressure is normal.

   This is very important, since the locomotive is equipped with electro-magnetic switchgear which will function in response to control and permit operation without air pressure for the brakes.

2. Check for proper application and release of air brakes.

3. Release hand brake and remove any blocking from under the wheels, if used.

CAUTION

It is desirable that engine water temperature be 49°C (120°F) or higher before full load is applied to the engine. After idling at ambient temperature below -18°C (0°F), increase to full load level should be made gradually.

HANDLING LIGHT LOCOMOTIVE

With engine started, unit set *on-line*, and preceding inspections and precautions completed, the locomotive is handled as follows:

1. Place the Engine Run switch and Generator Field switch in **ON** (up) position.
2. Switch headlights and other lights **ON** as needed.
3. Insert Directional (Reverser) handle and move it to the desired direction of travel, either **FORWARD** or **REVERSE.**
4. Release air brakes.
5. Advance throttle to notch 1, 2, or 3 as needed to move locomotive at desired speed.

NOTE

Locomotive response to throttle movement is almost immediate. There is little delay in power buildup.

6. Throttle handle should be returned to the **IDLE** position before coming to a dead stop.
7. Directional (Reverser) handle should be moved to change direction of travel **ONLY** when locomotive is completely stopped.

DRAINING AIR RESERVOIRS AND FILTERS

The air reservoirs and filters should be drained periodically even though the equipment is provided with automatic drain valves. Follow the maintenance schedule established by the railroad.

COUPLING LOCOMOTIVES TOGETHER

When coupling units together for multiple unit (consist) operation, follow procedure outlined below:

1. Couple and stretch units to ensure couplers are locked.
2. Install control cable between units.
3. Attach platform safety chains between units.
4. Perform ground, engineroom, and engine inspections, as outlined in preceding instructions.
5. Position cab controls for trailing unit operation as outlined in preceding instructions. Remove Directional (Reverser) handles from all trailing unit controllers to lock controls.
6. Connect air brake hoses between units.
7. Open required air hose cutout cocks on each unit.
8. Using the Automatic Brake Valve, apply the brakes on the consist to determine if brakes apply on each unit. Release the Automatic Brake Valve, then make sure brakes on each unit are released. Follow the same procedure to check Independent Brake application. Also, release an automatic service application by deflecting Independent Brake Valve handle down. Inspect brakes on all units in the consist to make sure they released.

COUPLING UNITS TOGETHER FOR DYNAMIC BRAKING

Locomotive is equipped with dynamic brakes. It makes use of the voltage level signal from the brake control rheostat (set by the Dynamic Brake handle) to control braking strength by controlling excitation of the main generator field. This signal is applied to a trainlined wire to control dynamic braking strength of all units coupled in consist. However, the total braking effort of a multiple unit consist can become quite high. Carefully observe railroad rules regarding multiple unit dynamic braking in critical service.

COUPLING LOCOMOTIVE TO TRAIN

Locomotive should be coupled to train using the same care taken when coupling units together. After coupling, make the following checks:

1. Test to see that couplers are locked by stretching connection.
2. Connect air brake hoses.
3. Slowly open air valves on locomotive and train to cut in brakes.
4. Pump up air using the following procedure.

PUMPING UP AIR

After cutting in air brakes on train, note the reaction of the main reservoir air gauge. If pressure falls below a specified low level, the computer will increase engine speed to throttle notch 2 automatically and display the **ENGINE SPEED INCREASE - LOW AIR PRESSURE** message, provided that the Isolation switch is in the **RUN** position. If the train is of significant length, it may be necessary to use a higher engine speed to pump up air as follows:

1. Set Generator Field switch in **OFF** (down) position.
2. Move Directional (Reverser) handle to **NEUTRAL** (centered) position.
3. Advance throttle to a higher notch setting as needed to speed up engine and thus increase air compressor output.

> **NOTE**
> Throttle may be advanced to notch 5 if necessary. Engine should not, however, be run unloaded (as in pumping up air) at speeds beyond throttle notch 5.

BRAKE PIPE LEAKAGE TEST

Prior to operating 26LUM air brake equipment, a leakage test must be performed. Brake pipe leakage tests should be made in accordance with railroad operating rules and Power Brake Law.

STARTING TRAIN

The method to be used in starting a train depends upon many factors such as: train type, weight, length, and amount of slack; track condition and grade; and weather conditions. Since all of these factors are variable, specific train starting instructions cannot be provided and it will, therefore, be up to the operator to use good judgement in properly applying the power to suit requirements. There are, however, certain general considerations that should be observed. They are discussed in the following paragraphs.

A basic characteristic of the diesel locomotive is its high starting tractive effort, which makes it imperative that the air brakes be completely released before any attempt is made to start a train. Allow enough time to fully release the air brakes before attempting to start the train.

The locomotive develops enough tractive effort to enable it to start most trains without taking up slack. The practice of taking up slack indiscriminately should, therefore, be avoided. There will, however, be situations in which it is advisable (and sometimes necessary) to take slack in starting a train. Care should be taken in such cases to prevent excessive locomotive acceleration which will cause undue shock.

Proper throttle handling is important when starting trains since it has a direct bearing on the power being applied. As the throttle is advanced, a power increase occurs almost immediately, and power applied is at a value dependent upon throttle position. It is therefore advisable to advance the throttle one notch at a time when starting a train.

A train should be started in as low a throttle position as possible, thus keeping the speed of the locomotive at a minimum until all slack has been removed and the train completely stretched. Sometimes it is advisable to reduce the throttle a notch or two at the moment the locomotive begins to move in order to prevent stretching slack too quickly or to avoid slipping.

When ready to start, use the following general procedure, or change it as required by prevailing conditions and/or railroad rules.

1. Set Isolation switch in **RUN** position.
2. Move Directional (Reverser) handle to the desired position, **FORWARD** or **REVERSE**.
3. Set Engine Run switch and Generator Field switch to the **ON** position (up).
4. Release both Automatic and Independent air brakes.
5. Advance the throttle one notch every few seconds as follows:

    a. To notch 1 - Loading will stop at a specific low

value. This may be noted on the load current indicating meter (ammeter). At an easy starting place, the locomotive may start the train.

> **NOTE**
> The design of the locomotive power control system makes it generally unnecessary to apply locomotive independent brakes or to manipulate the throttle between position notch 1 and **IDLE** during starting.

b. To notch 2, 3, or higher (experience and the demands of the schedule will determine this) until the locomotive moves.

6. Reduce throttle one or more notches if acceleration is too rapid.

7. After the train is stretched, advance throttle as desired.

> **NOTE**
> The locomotive wheel control system, operating in Super Series, reacts automatically to maximize tractive effort regardless of operating conditions. These conditions may include wet rail, oiled rail, and full throttle operation for maximum acceleration or climbing hills. The wheel control system is totally automatic and requires no driver action. Therefore, the wheel slip light does not come on while in Super Series above 1.5 MPH, unless a wheel overspeed, locked powered wheel, slipped pinion, plugged traction motor, or Super Series failure condition exists.

ACCELERATING A TRAIN

After the train has been started, the throttle can be advanced as rapidly as desired to accelerate the train. The speed with which the throttle is advanced depends upon demands of the schedule and the type of locomotive and train involved. In general, however, the throttle should be advanced one notch at a time.

The load current indicating meter (ammeter) provides the best guide for throttle handling when accelerating a train. Note that the pointer moves toward the right (increased traction motor current) as the throttle is advanced.

As train speed increases, the meter pointer begins moving toward the left. At that time, the throttle may again be advanced. Thus for maximum smooth acceleration, the throttle should be advanced one notch each time the meter pointer begins moving toward the left until full power is reached in throttle notch 8.

AIR BRAKING WITH POWER

Air brake equipment handling methods are left to the discretion of the railroad. However, when braking with power, remember that for any given throttle position, draw bar pull rapidly increases as train speed decreases. This pull might become great enough to part the train unless throttle notch is reduced as train speed decreases. Since locomotive pull is dictated by the amount of traction motor current, the operator can maintain a constant pull on the train during slow-down by keeping load current indicating meter amperage steady. This is accomplished by reducing the throttle one notch whenever amperage starts to increase (pointer moves to right). It is recommended that the independent brakes be kept fully released during power braking. The throttle must be in **IDLE** before the locomotive comes to a stop.

POWER AT STALL

Do NOT hold the train at standstill on a grade or with the brakes applied and the throttle open for power. Extensive damage to the traction motors is possible.

OPERATING OVER RAIL CROSSING

When operating locomotive at speeds exceeding 25 MPH, reduce throttle to notch 4 at least eight (8) seconds before locomotive reaches rail crossing. If locomotive is operating at notch 4, or running less than 25 MPH, allow same interval and reduce throttle to next lower notch.

Advance throttle after all units of the multiple-unit consist have passed over the crossing. This procedure is necessary to ensure decay of motor and generator voltage to a safe level before the mechanical shock that occurs at rail crossings is transmitted to the motor brushes.

RUNNING THROUGH WATER

CAUTION

Do not, under any circumstances, operate locomotive through water deep enough to touch bottom of the traction motors. Water any deeper than 3" above rail is likely to cause traction motor damage.

When passing through any water on the rails, exercise every precaution and never exceed 2 to 3 MPH.

WHEEL CONTROL SYSTEM

The wheel control system consists of the Super Series system and the wheel slip system. The locomotive control system computer automatically enables (switches on) the portion of the wheel control system appropriate for operating conditions.

The Super Series system functions by enabling the fastest-turning wheelset to rotate at a rate slightly faster than ground speed - that is, it enables the wheels to "creep." The system regulates the amount of wheel creep to maximize wheel traction.

The wheel slip system is divided into starting, backup, and dynamic braking operation portions. It senses and corrects wheel slip. (Wheel slip is wheel speed in excess of Super Series regulated wheel creep.)

Super Series is always enabled during motoring, except if something causes it to fail. During motoring below 1.5 MPH, the starting wheel slip system is also enabled; the dynamic braking wheelslip system is, of course, enabled during dynamic braking; the backup wheelslip system is enabled if Super Series fails during motoring above 1.5 MPH.

The Super Series and wheel slip systems automatically apply sand when warranted by severe rail conditions.

Depending on the severity of the wheel slip, the wheel slip indicator light on the Operator's Overhead Console may or may not flash on and off.

WARNING

OTHER CONDITIONS, SOME OF WHICH ARE ABNORMAL AND POSSIBLY DANGEROUS, CAN CAUSE THE WHEEL SLIP INDICATOR TO FLASH PERSISTENTLY OR TO LIGHT STEADILY. REFER TO THE FOLLOWING PARAGRAPHS.

WHEEL SLIP INDICATIONS

Five (5) different conditions can cause this indicator to light. Two of the conditions, **LOCKED POWERED WHEEL** and **SLIPPED PINION**, are abnormal and possibly dangerous; they require immediate attention and action by the crew. The other three conditions, **WHEEL SLIP**, **WHEEL SLIDE**, and **WHEEL OVERSPEED**, do not require immediate crew action. The following text describes the five conditions in more detail.

LOCKED POWERED WHEEL

It takes ten (10) seconds for the locomotive computer to detect this fault. Then, for the next five (5) seconds; the **WHEEL SLIP** indicator light will be **ON** continuously, traction power will be cut **OFF** and the computer will display the **#N LOCKED POWER WHEEL** message. Computer then allows traction power to return, and turns off the indicator light and the displayed message. If throttle is not returned to **IDLE**, the cycle will repeat. Note that the **WHEEL SLIP** light is trainlined.

WARNING

A LOCKED POWERED WHEEL ON A MOVING LOCOMOTIVE IS VERY DANGEROUS. IF A LOCKED POWERED WHEEL IS INDICATED, PROCEED AS DIRECTED AFTER NEXT LISTED CONDITION; SLIPPED PINION.

SLIPPED PINION

If the locomotive computer senses this fault (traction motor spinning too freely), it causes the **WHEEL SLIP** indicator to flash (cycle) **ON** and **OFF** (3 seconds on / 3 seconds off). In addition, the computer will display the **POSSIBLE SLIPPED PINION DETECTED/ VOLTAGE LIMITING IN ORDER TO VERIFY** message.

The **WHEEL SLIP** on and off cycle and the computer message display will continue while the computer tests the suspect traction motor circuit to verify the fault (Low-level power is applied to the traction motors during this test, which requires up to four [4] minutes).

If the computer *does not* verify the slipped pinion fault; it cancels the fault and the computer message display, turns off the **WHEEL SLIP** indicator light, and re-enables normal locomotive operation.

If the computer *does* verify the slipped pinion fault; it drops out power and dynamic brake operation until the fault is reset, latches in the fault condition, it displays the **MOTOR #N SLIPPED PINION LOCKOUT** message, and it continues to cycle the **WHEEL SLIP** indicator light. The fault must be cleared before the computer will stop cycling the **WHEEL SLIP** indicator light.

PROCEED AS FOLLOWS IF A LOCKED POWERED WHEEL OR SLIPPED PINION IS INDICATED:

1. STOP TRAIN.
2. DETERMINE WHICH UNIT HAS "LOCKED POWERED WHEEL" OR "SLIPPED PINION" INDICATION.
3. SLOWLY ROLL UNIT WITH INDICATION PAST AN OBSERVER WATCHING FOR SLIDING WHEELS AND/OR "BIRDNESTED" TRACTION MOTORS, WHILE LISTENING FOR UNUSUAL NOISES FROM TRACTION MOTORS AND GEARCASES.
   a. IF ANY WHEEL SLIDES, OR ANY TRACTION MOTOR APPEARS TO BE "BIRDNESTED," OR ANY TRACTION MOTOR OR GEARCASE MAKES AN UNUSUAL NOISE, THEN CONTACT THE TRAIN DISPATCHER FOR FURTHER INSTRUCTIONS.

   WARNING
   DO NOT, UNDER ANY CIRCUMSTANCES, TOW A UNIT HAVING SLIDING/ LOCKED WHEELS, OR MOVE SUCH A UNIT IN A LOCOMOTIVE CONSIST.

   b. IF ALL THE WHEELS ROLL FREELY, AND THE TRACTION MOTORS AND GEARCASES SOUND AND LOOK OK, THEN ATTEMPT TO RESUME OPERATION. IF A FAULT INDICATION RECURS, THEN CONSULT THE TRAIN DISPATCHER BEFORE PROCEEDING.

WHEEL SLIP

While starting a train *when rail conditions are exceptionally poor,* an *occasional* flash of the **WHEEL SLIP** indicator light indicates normal functioning of the system's wheel slip control, which may be accompanied by automatic sanding. Throttle reduction is not required unless severe lurching threatens to break the train.

NOTE

When rail conditions are poor and the locomotive is operating in power above 1.5 MPH, *occasional, irregular flashing* of the **WHEEL SLIP** light may indicate a Super Series failure. Operation may continue, but the condition should be reported to authorized maintenance personnel.

WHEEL SLIDE

While operating in dynamic brake, *intermittent* **WHEEL SLIP** indicator light *flashing* indicates normal wheelslide control, sometimes including automatic sanding.

WHEEL OVERSPEED

The indicator light will flash **ON** and **OFF** (3 seconds on / 3 seconds off) to indicate wheel (and traction motor) overspeed, and the computer will display the **WHEEL OVERSPEED** message. This can be caused by excessive track speed or by simultaneous slipping of all wheels. In either case, the system automatically corrects by regulating main generator output power. The computer message and indicator light flashing are automatically cancelled after recovery.

CUTTING OUT TRACTION MOTORS

To cut out a traction motor, refer to "T.M. CUTOUT & TRUCK DISABLED" in TROUBLESHOOTING Section 4, and observe the following:

WARNING

Before operating unit with cut out traction motor, roll unit past observer. Observer should make sure that wheels driven by the cut-out motor rotate freely, and that the cut-out motor (including gearcase) does not make any unusual noise and is not "birdnested."

LOCOMOTIVE SPEED LIMIT

The maximum speed at which the locomotive can be operated without endangering the traction motors is determined by traction motor to axle gear ratio and traction motor design. The maximum speed for this locomotive, as shipped from EMD, is 70 MPH. If the locomotive exceeds this speed, the locomotive computer will act to reduce the speed back to 70 MPH.

As locomotive wheels wear to smaller diameters, the maximum speed drops. See "WHEEL OVERSPEED," page 3-23.

Note: The locomotive speed indicator/recorder (Train Monitoring) system initiates a warning and will apply penalty braking if wheel speed is allowed to exceed 67 MPH.

SLOW SPEED CONTROL OPERATION

Request slow speed operation (**SSC** mode) through the locomotive computer display with the **SLOW SPEED** key on the keypad. Once the computer initiates slow speed operation, the display shows the **TARGET** (set) speed and actual speed (average axle speed) on the **SLOW SPEED** set-up screen.

A locomotive could be in slow speed operation well beyond the 30 minute blank screen timeout period without a key being pressed. For this reason, the blank screen function has been disabled when operating in slow speed mode. If the user moves on to a different screen function and there are no key presses for 10 minutes, the display returns automatically to the **SLOW SPEED** set-up screen.

If the set-up screen is overridden by a priority crew message, the operator can suppress the crew message and return to the set-up screen by pressing the **EXIT** key on the keypad.

NOTE

The **SLOW SPEED** set-up screen must be displayed in order for the operator to make speed adjustments with the **SPEED UP/DOWN** rocker switch on the Operator's Control Stand.

The **SPEED UP/DOWN** rocker switch is used in conjunction with the computer display panel to control the Slow Speed System. Pressing the switch rocker **UP** requests computer to raise the locomotive speed setting. Pressing the rocker **DOWN** requests a lower speed setting. Releasing the rocker enables spring pressure to return it to the **OFF** (centered) position.

The computer increases the Set Speed change rate when the rocker switch is held down for more than two (2) seconds; the Set Speed change rate increases further if the switch is operated for another two (2) seconds.

NOTE

The computer resets Set Speed to actual locomotive speed or 10 MPH (whichever is slower) when slow speed mode starts. It resets Set Speed to 0.0 MPH when Slow Speed Mode ends.

MIXED GEAR RATIO OPERATION

CAUTION

If units in a consist have different gear ratios, the locomotive should not be operated at speeds exceeding that recommended for unit with the lowest maximum permissible speed. Similarly, operation should never be slower than the minimum continuous speed (or maximum motor amperage) for units having established short time ratings. See "SPEED LIMITATIONS" in General Information Section 1 of this manual for information about this locomotive.

To obtain a maximum tonnage rating for any single application, upon request, Electro-Motive will analyze the actual operation and make specific tonnage rating recommendations.

DYNAMIC BRAKING

WARNING

The dynamic brake system is disconnected when operating with a traction motor cut out.

Dynamic braking can prove extremely valuable in retarding train speed in many phases of locomotive operation. It is particularly valuable while descending grades. **Dynamic braking retards locomotive wheel speed, but does NOT apply braking on the rest of the train.**

Maximum dynamic braking effort is obtained at a specific speed, depending on locomotive gear ratio. This model locomotive is equipped with 42" wheels and a 83:18 gear ratio and it will, therefore, obtain maximum braking effort at about 24 MPH. At train speeds higher than the optimum, braking effectiveness gradually declines as speed increases. Therefore, it is important that dynamic braking be started **before** train speed becomes excessive. While in dynamic braking, do **not** allow train speed to "creep" upward by careless handling of the brake.

To operate dynamic brakes, proceed as follows:

1. The Directional (Reverser) handle must be positioned in the direction of locomotive movement.

2. Return Throttle handle to **IDLE** position and wait for ten (10) seconds before proceeding.

> **WARNING**
> The ten (10) second delay must be completed before the Dynamic Brake handle is moved into **SET UP** position.
> **Braking delay occurs automatically. Do not misinterpret the delay as failure of the dynamic braking system.**
>
> It is possible for a sudden surge of braking effort to occur if the Dynamic Brake handle is advanced when the delay times out.

3. Move the braking handle into **SET UP** position. This establishes the dynamic braking circuits. It will also be noted that a slight amount of braking effort occurs, as evidenced on the load current indicating meter.

4. After the slack is bunched, advance the braking handle past **SET UP** position to initiate dynamic braking. As it is advanced out of **SET UP** it will be noted that the engine speed automatically increases.

5. As Dynamic Brake handle position advances to right, from position 1 toward position 8, braking effort increases on this locomotive, which has grid current controlled dynamic brakes.

   Older-model trailing units may not have the same dynamic brake system as this unit and, therefore, may not react in the same manner when the Dynamic Brake handle is moved. Figure 3-2, page 3-30, and Figure 3-3, page 3-31, illustrate the differences.

6. With automatic regulation of braking current, the **BRAKE WARN** indicator light on the Operator's Overhead Console should seldom come **ON**. If the **BRAKE WARN** indicator light does flash **ON**, however, stop advancing the handle until the light goes out.

7. If the **BRAKE WARN** indicator light fails to go out after several seconds, move the handle back slowly until the light does go out. After the light goes out, the handle may again be advanced to increase braking effort.

CAUTION

The BRAKE WARN indicator light circuit is trainlined so that a warning will be given in the lead unit if any unit in the consist is generating excessive current in dynamic braking. Thus, regardless of the load current indicating meter reading or handle position (which may be less than maximum), whenever the warning light comes on (without a warning alarm), it should NOT be allowed to remain on for any longer than two (2) to three (3) seconds before steps are taken to reduce braking effort.

If **BRAKE WARN** light indications are repeated, the locomotive should be taken out of dynamic braking and the dynamic brake cutout switch on the engine control panel of the affected unit should be placed in **OFF (cut out)** position. The locomotive consist will then operate normally under power and during dynamic braking, but with reduced total braking effort.

8. When necessary, the Automatic (air) Brake may be used in conjunction with the Dynamic Brake. However, the Independent (air) Brake must be kept FULLY RELEASED whenever the Dynamic Brake is in use, or the wheels may slide. As speed decreases below peak braking effort speed, on units without the extended speed range feature, the Dynamic Brake becomes less effective. When the speed further decreases on these units, it is permissible to completely release the

Dynamic Brake by placing the handle back in the **OFF** position, applying the Independent (air) Brake simultaneously to prevent the slack from running out.

CAUTION

When operating in Dynamic Brake, an air brake application caused by an emergency or Train Monitoring system function will disconnect the dynamic brake system.

DYNAMIC BRAKING WHEN COUPLED TO OLDER-MODEL UNITS

The locomotive can be operated in dynamic braking when coupled to older units that are not equipped with brake current limiting regulation. If all the units are of the same gear ratio, the unit having the lowest maximum brake current rating should be placed as the lead unit in the consist. The operator can then operate and control the braking effort up to the limit of the unit having the lowest brake current rating, without overloading the dynamic brake system of a trailing unit. The locomotive consist MUST always be operated so as not to exceed the braking current of the unit having the lowest maximum brake current rating.

Units equipped with dynamic brake current limiting regulation can be operated in multiple with other locomotives in dynamic braking regardless of the gear ratio, wheel size, or difference in the maximum brake current ratings.

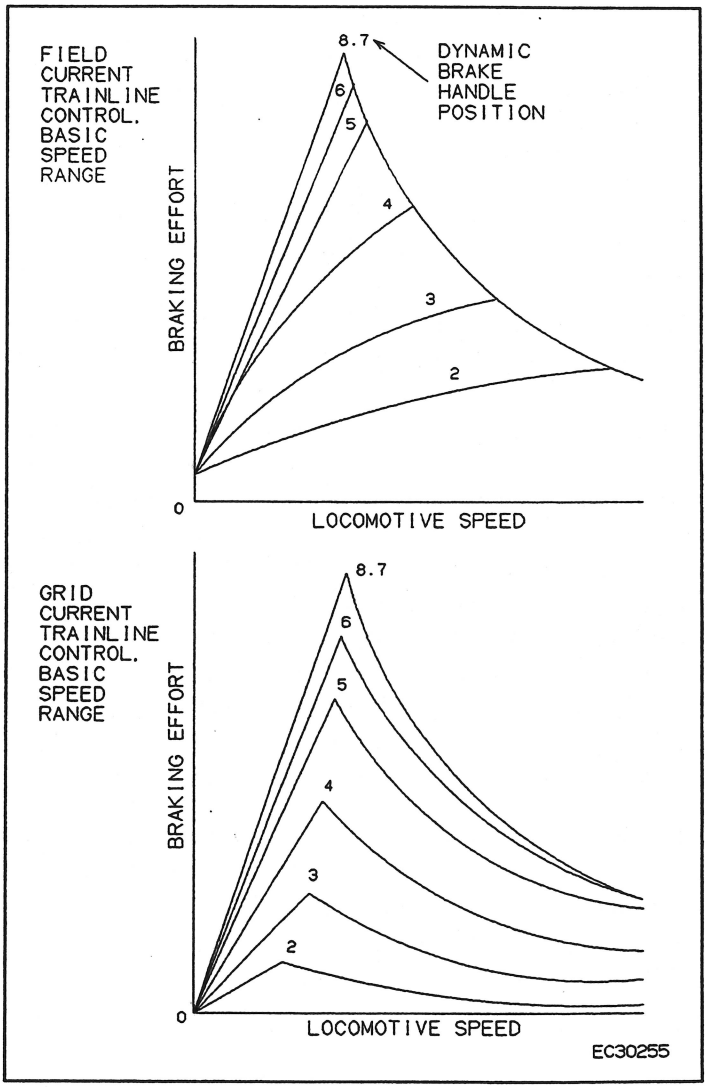


Figure 3-2. Speed vs. Dynamic Brake Effort (Pt. 1 of 2)

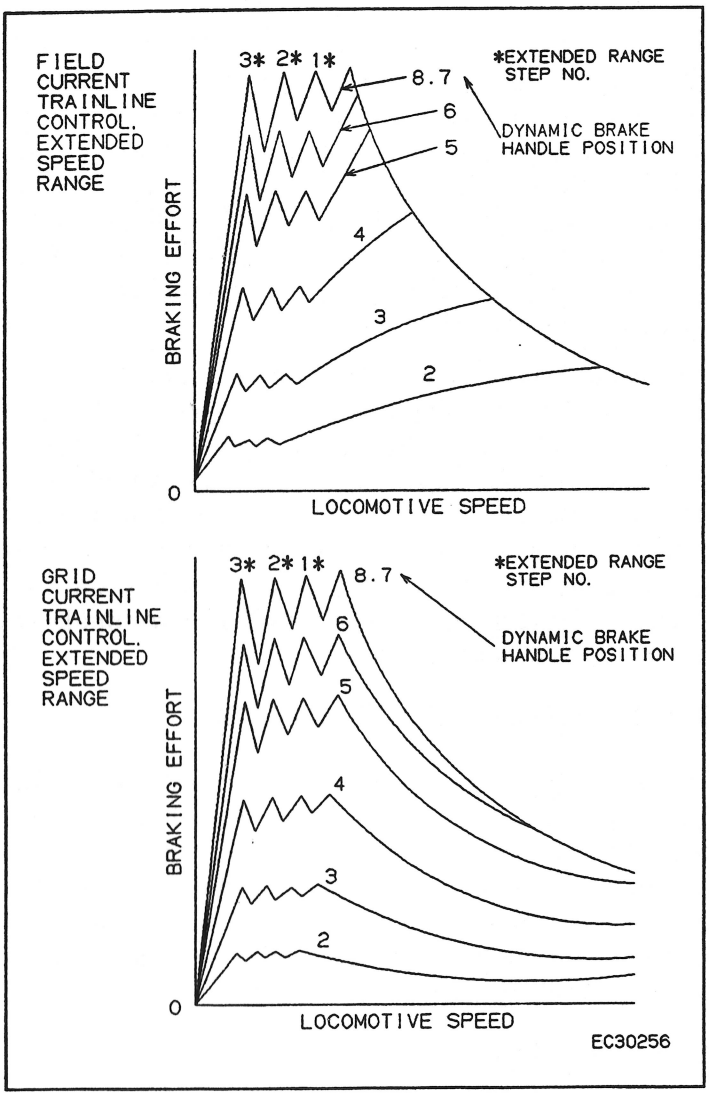


Figure 3-3. Speed vs. Dynamic Brake Effort (Pt. 2 of 2)

DYNAMIC BRAKE WHEEL SLIP CONTROL

In dynamic braking, wheel slip is called "wheel slide," which means that one wheelset is decelerating more quickly than the others and sliding on the rail. Wheel slides are somewhat self-correcting due to the dynamic brake grids/traction motors circuit design. However, the locomotive computer wheel slip control routine operates during dynamic braking as well as during power operation. This protection provides extremely stable dynamic brake operation.

In dynamic braking, when the computer detects that one pair of wheels is rotating more slowly than the others, it acts to reduce braking effort and to apply sand in order to correct the wheel slide. After the wheelset resumes normal rotation, the braking effort of the traction motors returns (increases) to its former value. Automatic sanding continues for a short period after the wheel slide is corrected. In addition, ***manual sanding is available at any speed in dynamic braking.***

OPERATION IN HELPER SERVICE

Basically, there is no difference in the instructions for operating the locomotive ***as*** a helper or ***with*** a helper. In most circumstances, it is desirable to get over a grade in the shortest possible time. Therefore, wherever possible, operation on grades should be at FULL throttle. The throttle should be reduced, however, if wheel slips cause lurching that threaten to break the train.

ISOLATING UNIT

When it is necessary to isolate a locomotive unit, observe the following:

1. When operating in power in a multiple unit consist, a unit may be isolated at any time, but discretion as to timing and necessity should be used.

2. When operating in dynamic braking, it is important to get out of dynamic braking before attempting to isolate the unit. This is done by moving the throttle handle in the lead unit to **IDLE** position. The **ISOLATION** switch can be moved to the **START/STOP/ISOLATE** position to eliminate the braking on that unit. If the braking is resumed, other units will function normally.

NOTE

Trainline connections enable isolated unit to function as the lead (controlling) unit of a consist if its battery knife switch is closed and all breakers in the shaded (black labeled) areas of the circuit breaker panels are **ON** (up).

CHANGING OPERATING ENDS

When the locomotive consist includes two or more units with operating controls, the following procedure is recommended in changing from one operating end to the opposite end on units equipped with 26LUM brakes.

ON END BEING CUT OUT

1. Move Automatic Brake Valve handle to the SERVICE ZONE, and make a 138 kPa (20 psi) reduction.
2. After brake pipe exhaust stops, place Cut-Off Pilot Valve in **OUT** position by pulling knob up and turning valve lever.
3. Set Independent Brake Valve handle in the **REL (Release)** position.
4. Set MU-2A valve to the **TRAIL** position, as indicated at the valve handle.
5. Set Automatic Brake Valve handle in the **H O (Handle Off)** position.
6. With Dynamic Brake handle in **OFF** position and

Throttle in **IDLE**, place the Directional (reverser) handle in **NEUTRAL** (centered) position and remove it to lock the controls.

7. Place all switches at the Control Stand in the **OFF** positions (down). Be absolutely certain that the Fuel Pump & Control switch, Generator Field switch, and Engine Run switch are in the **OFF** position (down).

8. At Engine Control Panel, set Headlight Control switch in proper position for trailing unit operation. Place other switches **ON** as needed.

9. At the Circuit Breaker Panels, all circuit breakers in the shaded (black labeled) areas are to remain in the **ON** (up) positions.

10. After completing the operations outlined in the preceding steps, move to the cab of the new lead unit.

ON END BEING CUT IN

1. At the Control Stand, make certain that the Generator Field switch is **OFF** (down).

2. Insert Directional (Reverser) handle and leave it in the **NEUTRAL** (centered) position.

3. Place Automatic Brake Valve handle in the **SUP (Suppression)** position to nullify any safety control (TMS/ Vigilance) or overspeed control used.

4. Move Independent Brake valve handle to the **APP (Full Application)** position.

5. Place the Cut-Off Pilot Valve to either **FRT** or **PASS** position, depending on make-up of train.

6. Place MU-2A valve to the **LEAD OR DEAD** position.

7. At the Circuit Breaker Panels, make sure all circuit breakers in shaded (black labeled) areas are in the **ON** (up) positions.

8. At the Engine Control Panel, set the Headlight Control switch in the proper position, and set other switches **ON** as needed.

9. At the Control Stand, set the Fuel Pump & Control switch, Generator Field switch, and the Engine Run switch in the **ON** (up) position. Other switches may be placed **ON** as needed.

STOPPING DIESEL ENGINE

Normal engine stops can be made using any one of the following switches:

1. Press **EMERGENCY FUEL CUTOFF & ENGINE STOP** push-button on the Engine Control Panel.

   When locomotive is at stand still or under power, the Isolation switch should be placed in **START/ STOP/ ISOLATE** position. The stop push-button can then be pressed to stop the engine. Since reaction of the stop push-button is almost instantaneous, it need not be held in longer than about one (1)second.

2. Press an Emergency Fuel Cut-Off (EFCO) Button.

   Emergency Fuel Cut-Off push-buttons are located near each fuel filler opening (2) and at the side of the No. 3 AC electrical cabinet (engine start station). These push-buttons operate in the same manner as the stop push-button on the Engine Control Panel, and need not be held in nor reset. However, it is necessary to hold the button in for approximately one (1) second to ensure that switch actuation is recognized as a proper shut-down signal.

In addition to the normal engine stop function switches, there are several additional engine stop functions provided by the EMDEC system:

1. At the annunciator (fault) panel on the side of the No. 3 AC Electrical Cabinet, place the **FUEL INJECTION** switch in the ***STOP*** (down) position.

2. At the No. 1 Electrical Control Cabinet (Circuit Breaker Panels), place the **ENGINE CONTROL** circuit breaker in the **OFF** (down) position, or open the battery knife switch.

NOTE

The **FUEL INJECTION** switch, **ENGINE CONTROL** circuit breaker and battery knife switch will cut off fuel injection to cause an immediate engine shut down. In addition, it is possible to switch off the **FUEL PUMP** circuit breaker to stop the engine by fuel starvation, however, this method is <u>not</u> recommended. It should only be used as an emergency stop if there is a problem stopping the engine in a normal manner.

Normal engine stops using EFCO engine stop switches will cause the **SYSTEM READY** light on the EMDEC annunciator (fault) panel to turn **OFF** and remain **OFF** until engine shutdown circuit is reset by placing the Fuel Prime/Engine Start (FP/ ES) switch in the **FUEL PRIME** or **ENGINE START** position. The **SYSTEM READY** light will <u>not</u> go **OFF** if engine was shut down by the EMDEC protection system.

FREEZING WEATHER PRECAUTIONS

As long as the diesel engine is running, the cooling system will be kept adequately warm regardless of ambient (outside) temperatures encountered. It is only when the engine is shut down or stops for any reason that the cooling system requires protection against freezing.

Whenever the engine is shut down, and freezing temperatures are possible, the cooling system should be drained or otherwise protected from freezing. This protection will be provided by the Automatic Cooling System Drain Valve (if applied) when control circuit is properly armed. Refer to "ARMING THE AUTOMATIC COOLING SYSTEM DRAIN VALVE CIRCUIT" following.

DRAINING COOLING SYSTEM MANUALLY

When necessary to manually drain the cooling system, open the manual system drain valve located in the sump (pit) between the engine and equipment rack. This valve will drain the engine, water tank, water cooled air compressor and associated piping.

CAUTION

If a hot engine is being drained, always allow the engine to cool down before refilling with coolant.

ARMING THE AUTOMATIC COOLING SYSTEM DRAIN VALVE CIRCUIT

When this circuit is armed, it will activate the automatic cooling system drain valve in freezing temperatures to protect the engine and air compressor cooling systems when the engine is not running. If the circuit is *not* armed, and both the battery knife switch and the **COMPUTER CONTROL** Circuit Breaker are closed, the computer will display the **WATER DRAIN DISABLED OR CIRCUIT BREAKER OPEN** message, and the alarm will sound. (**CONTROL** Circuit Breaker must be closed for alarm to activate.) To manually drain the system, use the manual drain valve (as previously described), not a test switch on the automatic drain valve (if provided). Both valves will be located in the sump (pit) between the engine and equipment rack.

To arm the circuit for automatic operation, proceed as follows:

1. If engine is stopped, remove **STARTING** fuse in order to avoid cranking (or starting) of engine during arming of automatic drain circuit.

2. Close **AUTO WATER DRAIN** Circuit Breaker.

3. Turn Fuel Prime/ Engine Start (FP/ES) switch to the **ENGINE START** position momentarily. Circuit should arm.

Note: This step is not necessary if engine is running; circuit arms automatically if **AUTO WATER DRAIN** breaker is closed and engine is running. To perform test described in the following step, however, engine must be stopped.

4. Open and close the automatic drain valve momentarily by operating test switch on the valve (if provided). Operation of valve indicates circuit is properly armed. Repeat step 3 above if valve does not operate.
   With engine stopped, the **AUTO WATER DRAIN** Circuit Breaker must remain closed and the **AUTO. DRAIN COLD WATER FILL** switch (on the starting controls junction box) must NOT be operated in order for the circuit to remain armed.

5. To enable refilling cooling system with cold water, override the automatic cooling system drain circuit to close the drain valve by pressing the **AUTO. DRAIN COLD WATER FILL** push-button switch on the starting controls junction box while the engine is stopped. The alarm should sound and the computer should display the **WATER DRAIN DISABLED OR CIRCUIT BREAKER OPEN** message.

TOWING LOCOMOTIVE IN TRAIN

When a locomotive equipped with 26LUM air brakes is to be towed in a train, set control and air brake equipment as follows:

1. Drain all air from main reservoirs and air brake equipment, unless engine is to remain idling.
2. Place Multiple Unit (MU-2A) Valve in the **LEAD OR DEAD** position, as indicated at the valve handle.
3. Place Cut-Off Pilot Valve in **OUT** position.
4. Place Independent Brake Valve handle in **REL (Release)** position.
5. Place Automatic Brake Valve handle in **H O (HANDLE OFF)** position.
6. Cut in Dead Engine Fixture by turning it to the **DEAD** position. Dead Engine Fixture is located beneath cab floor, and may be reached through an access door on the operator's (right) side of the locomotive.
7. If engine is to remain idling, switches should be positioned as follows:
   a. **ISOLATION** switch in the **START/STOP/ISOLATE** position.
   b. Main battery knife switch closed (up).
   c. Ground Relay Cutout switch closed (up).
   d. Generator Field Circuit Breaker **OFF** (down).
   e. All breakers in shaded (black labeled) areas of the Circuit Breaker Panels in the **ON** (up) position.
   f. Starting Fuse should be removed.
   g. Aux. Gen. Circuit Breaker should remain in the **ON** (up) position.

h. Fuel Pump & Control switch **ON** (up).

i. Fuel Pump circuit breaker **ON** (up).

j. Throttle handle in **IDLE** position.

k. Directional (Reverser) handle in **NEUTRAL** (centered) position. Remove handle to lock the controls.

8. If locomotive is to be towed DEAD in train, set switches as follows:

   a. Main battery knife switch open (down).

   b. All circuit breakers **OFF** (down).

   c. All control switches **OFF** (down).

   d. **STARTING** fuse removed.

   e. Throttle handle in **IDLE** position.

   f. Directional (reverser) handle in **NEUTRAL** (centered) position. Remove handle to lock the controls.

CAUTION

If there is danger of freezing, the engine cooling system should be drained. Refer to, "FREEZING WEATHER PRECAUTIONS" on page 3-36.

LEAVING LOCOMOTIVE UNATTENDED

If at any time it is necessary to leave the locomotive unattended while the engine is running, the following procedure should be adhered to:

1. Observe all railroad safety precautions.
2. Set Engine Run switch and Generator Field switch in the **OFF** (down) position.
3. Set Throttle handle in **IDLE** position.
4. Place Directional (Reverser) handle in **NEUTRAL** position. Remove the handle to lock the controls.

CHARGING BATTERIES FROM AN EXTERNAL POWER SOURCE

1. Open the main battery knife switch.
2. Set all circuit breakers in the **OFF** (down) position.
3. Connect a 64 volt DC power supply to the battery charging receptacle on the right side of the locomotive underframe.

CAUTION

Care should be exercised to be certain that batteries are not short circuited and that the locomotive electrical systems are not subjected to reverse polarity.

4. Close the main battery knife switch.

Section 4. TROUBLESHOOTING

INTRODUCTION

This section provides information pertaining to messages conveyed to the locomotive operating crew by means of the EM2000 Computer Display Diagnostic System and indicator lights in the Operator's Overhead Console or on the EMDEC Annunciator (Fault) Panel, located in the engineroom on the No. 3 AC Electrical Cabinet. For convenience, the EM2000 Computer Display Diagnostic System is described in detail first to familiarize the operating crew with its use, followed by a listing of potential display messages. Information about the Overhead Console indicator lights is then provided, followed by a section on EMDEC fault indicator lights and system diagnostics.

EM2000 COMPUTER DISPLAY DIAGNOSTIC SYSTEM

The microprocessor display panel, Figure 4-1, page 4-2, is made up of a 6 line, 40 column vacuum fluorescent display with a 16 button back-lit tactile feedback keypad. This panel, combined with the locomotive control computer, is referred to as the Display Diagnostic System (DDS).

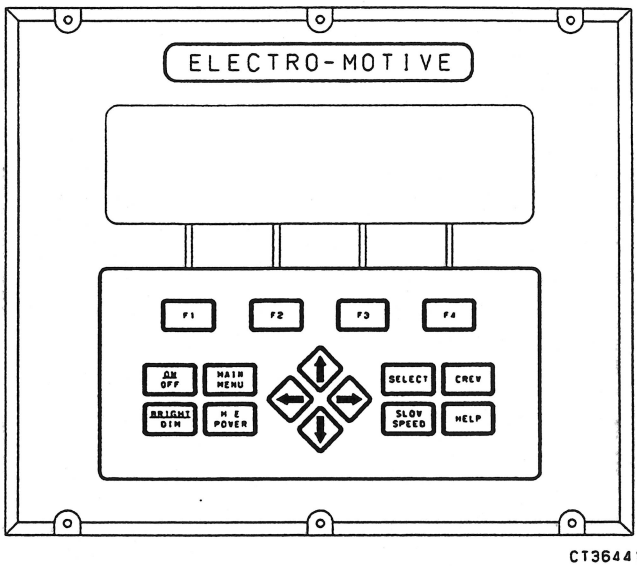


Figure 4-1. DDS Microprocessor Display Panel.

The Display Diagnostic System is an interactive device that provides an interface between the control computer (microprocessor) and locomotive operating crew. Access to the Locomotive Control Computer is provided through the display screen and keypad. The operator can observe the display screen and can input to the computer through the keypad. The computer directs operator input by providing "messages" on the screen. These messages indicate locomotive control and maintenance functions. Display screen set up and manipulation are dictated by the intended usage - operation or service.

SPECIAL NOTICE

This manual is intended primarily for locomotive operation with little emphasis on maintenance. Refer to the Locomotive Service Manual for more detailed information on locomotive maintenance.

Some of the illustrations in this section are electronic simulations of the display screen and may not precisely emulate the actual physical presentation.

DISPLAY SYSTEM CHARACTERISTICS

KEYPAD

The keypad, Figure 4-2, page 4-5, is equipped with 16 push-buttons (keys) that operate tactile feedback switches - these switches exhibit physical movement when operated. The following list defines the purpose of each key on the keypad.

1. **F1, F2, F3, F4** are ***function*** keys. The term "function" key is used to specify keys that are not defined in the same way for every screen. The purpose of these keys is to provide greater flexibility in menu selection.

   On any given screen the function keys represent an instruction to the control computer such as reset a fault, cut out a traction motor or a truck, request more information about other stored data, etc.

   The function keys are located immediately under the actual display screen. The bottom line on the screen provides the definition for the function keys that are active on that screen.

1. **ON/OFF** provides input power control for the display.
2. **MAIN MENU** returns screen to main menu in one keystroke.
3. **BRIGHT/DIM** controls screen intensity.
4. ***HE POWER***: Not used.
5. **Cursor Arrow Keys** are used to move the on-screen cursor to a different position (up/down & left/right).
6. **SELECT** engages the menu item at the cursor location.
7. **CREW** returns screen to crew message function in one keystroke.
8. **SLOW SPEED** is used to select the SLOW SPEED display screen. The slow speed screen displays the target speed required and the present locomotive speed. A speed setting is made with the Slow Speed Control switch located on the Operator's Control Stand.
9. **HELP** provides information about the current screen and explains available options.

Figure 4-2. Key Designations.

DISPLAY SCREEN

The display screen has six (6) horizontal lines which are designated for reference as shown in Figure 4-3.

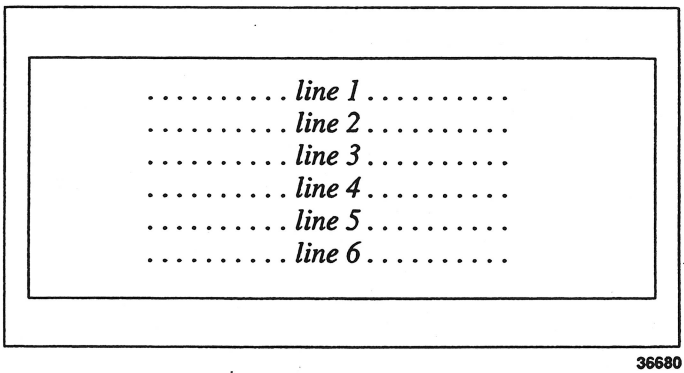


Figure 4-3. Display Screen Layout.

Display screens are limited to four (4) major classifications which are described as follows.

1. ***CREW MESSAGES*** - replaces annunciator module and local engine indicator lights used on previous model locomotives. See NOTE on following page.

2. ***MAIN MENU*** - user options that include service functions that are routinely performed by the operating crew such as fault reset, etc.

3. ***SLOW SPEED*** - replaces separate slow speed control systems.

4. ***BLANK*** - reduces the annoyance of screen illumination when it is not in use.

NOTE

CREW MESSAGES actually display normal operating conditions as well as problems that occur on the locomotive, such as:

1. engine speedup for low water temperature

   or

2. locomotive is not properly set up for the requested mode of operation

   or

3. power is limited

   or

4. some piece of equipment or system has failed and a protective function is active

SCREEN MANIPULATION

Diagnostic Display System operation is based on a cursor driven menu system. This system requires a user to move a cursor on the screen to the desired option and operate a function key (such as **CUT OUT**) to engage that option. The cursor is defined by two single line arrowheads as shown -

➤ . . . . . ◄

The cursor can be moved using the cursor movement keys which are labelled with arrows pointing in the desired cursor direction. If the display screen is made up of two (2) or more columns, then the ***down*** key will move the cursor from the top left position to the bottom of the left column and then appear at the top of the next right-hand column. Once the cursor is located at the desired listed item, that option can be realized by pressing the **SELECT** function key.

DISPLAY SYSTEM OPERATION

The Display Diagnostic System is available for both operation and service functions. Operation includes some service related procedures like traction motor cutout and fault reset.

1. OPERATION - by locomotive crew involves using only *CREW MESSAGE* screens to monitor unusual operating or fault conditions and to cut out a motor or reset a fault.

2. SERVICE - by maintenance personnel involves two (2) types of screens:

   - examining *CREW MESSAGE* screens for fault conditions.

   - using *MAIN MENU* screens for load test, self tests, meter screens, and other troubleshooting data.

Some of these display system operating modes are described in greater detail later in this section.

NOTE

This locomotive model is equipped for traction motor cutout of all six (6) traction motors and truck cutout. If a traction motor blower fault causes truck power lockout and a crew message, then the truck must be cut out to continue operation.

DISPLAY POWER UP

When the Display Diagnostic System is initially powered up, after a shutdown, the following events will occur on the display screen -

NOTE

The control computer displays and/or stores certain fault conditions by way of a *fault annunciator* system that is reset only when the **date** is set (or reset) in the control computer.

1. Fault messages that occurred since the fault annunciator was reset are stored in archive (non-volatile) memory. A *Maintenance Information Stored* message will appear at the top of the screen for ten (10) seconds.

2. If there are no stored (archived) fault messages and there are active crew messages, then the computer will display them on the ***CREW MESSAGE*** screen. For more information refer to **CREW MESSAGES** on page 4-10.

3. If there are no active crew messages, then the computer directs the display to the ***MAIN MENU*** screen, as shown on page 4-18.

NOTE

Only one (1) message can be displayed on the screen at a time. Each message has been assigned a specific ***priority*** for display. This priority is established in order of importance to the operator and to the locomotive. The control computer uses this priority to determine which message will take precedence for **display** on the screen.

CREW MESSAGES

The *CREW MESSAGE* screen is the center point of the display architecture because it will annunciate fault conditions that require immediate attention - important crew messages will interrupt the other display functions.

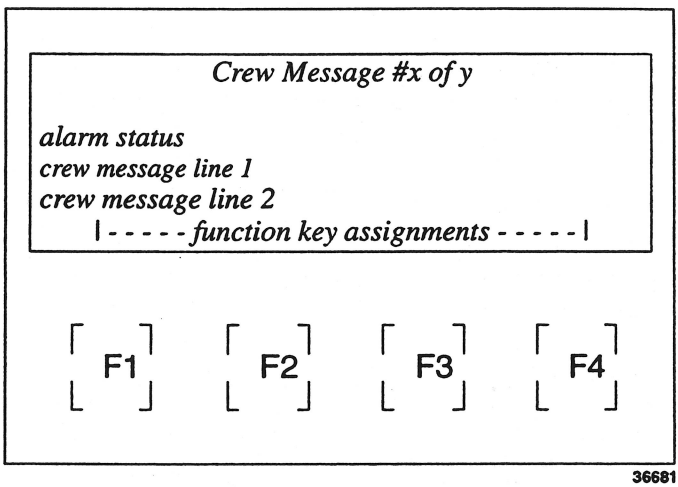


Figure 4-4. Crew Message Format.

Figure 4-4 illustrates the format used for all crew messages where -

line 1 - **x** is the number of the message.

line 1 - **y** is the number of available messages.

line 2 - will be either blank or **ALARM** if the crew message has caused the alarm to sound.

line 3 and line 4 - contain the crew message.

line 5 - blank

line 6 - function key assignments.

See page 4-21 for a list of typical crew messages.

FUNCTION KEY ASSIGNMENTS

In normal operation the function keys are defined for crew messages as follows:

- RESET - appears for a fault/lockout message.
- CUTOUT - appears if the message requires cutting out a device.
- NEXT - appears to display a different available message of lower priority.
- PREVIOUS - appears to display a different available message of higher priority.

FAULT RESET

A typical crew message is shown in Figure 4-5 where a grid overcurrent fault is annunciated by the message **REDUCED DYNAMIC BRAKE - GRID OVERCURRENT**. This fault can be reset by operating the F3 function key as directed by the ***RESET FLT*** indication providing that the fault condition is not still present.

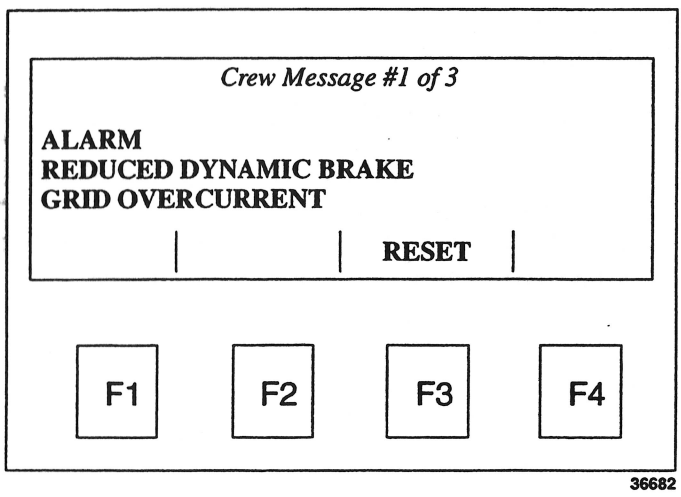


Figure 4-5. Typical Crew Message.

T.M. CUTOUT & TRUCK DISABLE

The traction motor cutout function replaces the traction motor cutout switch on the engine control panel of previous locomotive models. This option allows the status of all six (6) traction motors to be observed on the display screen and any traction motor to be *cut out* or *cut in* through the display.

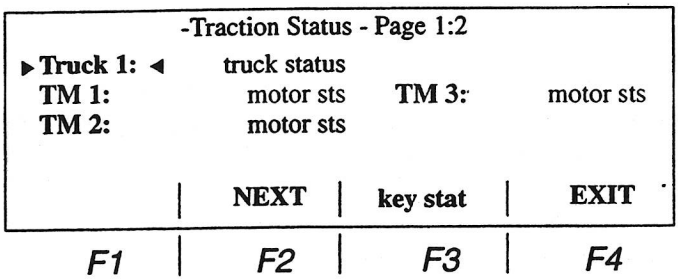
This locomotive model has separate traction motor blowers for each truck. If one of the blowers fail, then it would be advantageous to *cut out* that blower and the associated traction motors allowing the locomotive to be powered by the other truck/traction motor assembly. The entire truck can be electrically disabled or enabled through the display.

Both traction motor cut out/cut in and truck disable/enable can be performed with the ***TRACTION STATUS*** display screen, Figure 4-6, page 4-13. This screen covers truck 1 and motors 1, 2, and 3, with the second page of the display screen for truck 2 and motors 4, 5, and 6.

Note: The locomotive unit **must not be loading** while trying to perform either traction motor cut out/cut in or truck disable/enable.

The Traction Status screen can be accessed in two ways -

1. by selecting **TRACTION CUT OUT** on the ***MAIN MENU*** screen.
2. by operating the **CUT OUT** function key on a ***CREW MESSAGE*** screen indicating a faulted device.




```
Where:
 Truck status = DISABLED or ENABLED
                or FAILED or TRANSFER
 motor sts = CUT OUT or CUT IN or
             FAILED or TRANSFER
             or TRUCK CO
 key stat = CUT OUT or CUT IN
            or ENABLE or DISABLE
```

Figure 4-6. Traction Motor And Truck Electrical Status.

Function key **F3** will be defined as follows -

- If the cursor is positioned on a truck whose status is ***FAILED*** (failed to cut out) or ***DISABLED***, then **F3** will be ***ENABLE***.
- If the cursor is positioned on a truck whose status is ***FAILED*** (failed to cut in) or ***ENABLED***, then **F3** will be ***DISABLED***.
- If the cursor is positioned on a motor whose status is ***FAILED*** (failed to cut out) or ***CUT OUT***, then **F3** will be ***CUT IN***.
- If the cursor is positioned on a motor whose status is ***TRUCK CO***, then **F3** will be left blank.

NOTE

If a fault causes power lockout and a crew message, then a traction motor must be *cut out,* or a truck *disabled* in order to continue operation.

PROCEDURE TO CUT OUT OR CUT IN A TRACTION MOTOR OR TRUCK

Traction Status Change

Changes in traction status are usually brought about by some fault condition which is indicated by a crew message on the screen. Traction status changes are as follows:

- **Cutting out or cutting in one or more traction motors.**
- **Disabling or enabling a truck - all motors on a truck and its attendant blower motor are cut out or cut back in.**

In order to change the status of a traction motor or truck, the unit must have the Isolation switch in the* START/STOP/ISOLATE *position.

For each fault condition, a crew message will be displayed that identifies the fault and assigns it to a truck or motor. If the condition requires that a traction motor be *cut out* or a truck *disabled*, then the procedure would be as follows:

CUTTING OUT OR CUTTING IN A TRACTION MOTOR

1. The **CUT OUT** indication will be illuminated (*above F3*) on the ***CREW MESSAGE*** screen displaying the fault message.

2. Press the CUT OUT function key (*F3*) to bring up the ***TRACTION STATUS*** screen. (Figure 4-6, page 4-13).

   Note: The ***TRACTION STATUS*** screen can also be accessed directly from the ***MAIN MENU*** screen by selecting the **Traction cut out** option.

3. On the ***TRACTION STATUS*** screen the "key stat" function key (***F3***) can be designated as - CUT OUT or

CUT IN for a faulted traction motor. Moving the cursor to the desired motor causes the status of that traction motor to be displayed.

4. If the cursor is at *Motor #1:* and motor 1 is *cut in*, then only **CUT OUT** and **EXIT** are available (illuminated) since this motor is already *cut in.*

5. Press **CUT OUT** key (*F2*) to *cut out* the motor. If the cutout process is successful, Motor #1 status will change to **CUT OUT** on the display.

FAILURE OF MOTOR TO CUT OUT

If a traction motor cannot be *cut out* through the display, then either the locomotive is loading or there is a failure in the system.

- A failure in the system will cause that motor's status on the screen (motor sts) to change to FAILED and the F3 function key will read CUT IN as long as the cursor is located at that motor.

- If the unit is loading when the CUT OUT function key is operated, then the screen of Figure 4-7, page 4-16, will appear. The user can either press the EXIT function key or place the Isolation switch in **START/STOP/ISOLATE** position.

Moving the Isolation switch to **START/STOP/ISOLATE** or moving the throttle handle to **IDLE** will begin the cut out process. While the system is transferring from load to idle to cut out, the motor status (motor sts) will read TRANSFER which is replaced by either CUT OUT, CUT IN, or FAILED for that motor.

Note: During transfer from load to a different motor state (TRANSFER motor status) no keys on the keypad are active.

If the message **UNIT NOT ISOLATED** appears on line 5, the Isolation Switch should be placed in the **START/STOP/ISOLATE** position, or the **EXIT** key may be pressed to abort the process.

Several conditions may also exist which prevent a traction motor from being cut back in. These too will appear as a change in motor status (motor sts) on the screen to FAILED.

- This may also be due to a failure in the system and, therefore, the motor can only be cut back out.
- **MOTOR IS CUTOUT DUE TO A FAULT.** This is due to an open motor fault and, therefore, the motor *cut in* attempt failed. The process should be aborted by pressing the **EXIT** key.
- Press **EXIT** key (*F4*). to return display to the ***MAIN MENU.***

FAILURE OF MOTOR TO CUT IN

If a traction motor cannot be *cut in* due to a failure in the system, then the motor status (motor sts) will change to FAILED and the F3 function key will read CUT OUT as long as the cursor is on that motor. The motor can be cut out with the procedure of "FAILURE OF MOTOR TO CUT OUT," page 4-15.

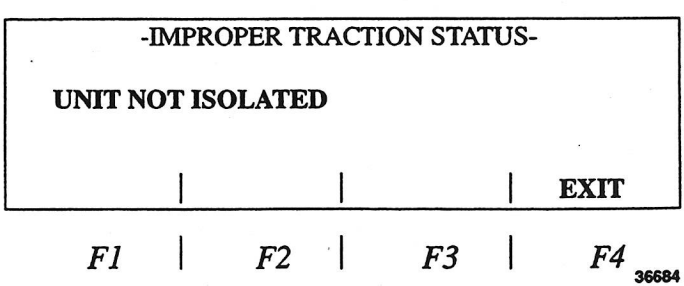


Figure 4-7. Failed Entry Condition For Change Of Traction Status.

DISABLE OR ENABLE A TRUCK

A failure of the a traction motor blower will produce a crew message such as **TRACTION MOTOR BLOWER #1 IS NOT TURNING**. If the CUT OUT function key (***F2***) on the ***CREW MESSAGE*** screen is operated, then the screen will change to the ***TRACTION STATUS*** screen of Figure 4-6, page 4-13, to allow the appropriate truck to be *cut out*.

1. The **CUT OUT** indication will be illuminated (*above F3*) on the ***CREW MESSAGE*** screen displaying the fault message.

2. Press the CUT OUT function key (*F3*) to bring up the Traction Status screen. (Figure 4-6, page 4-13.)

   Note: The ***TRACTION STATUS*** screen can also be accessed directly from the ***MAIN MENU*** screen by selecting the **Traction cut out** option.

3. On the ***TRACTION STATUS*** screen the "key stat" function key (***F3***) can be designated as - ENABLE or DISABLE for a faulted a truck blower.

   Changing the page and/or moving the cursor to the desired truck causes the function key to indicate the state of that device.

4. The status of the truck is displayed.

5. If the cursor is at *Truck 1:* and truck 1 is ENABLED, then only **DISABLE** and **EXIT** are available (illuminated) since this truck is already enabled.

6. Press **DISABLE** key (*F3*) to cut out the # truck.

   - During the cutout process, the truck status will change to TRANSFER while the cut out is in process.

     Note: No other keys will be available while this message is displayed.

- If the cutout process is successful, Truck 1 status will change to **DISABLED** on the display.

MAIN MENU

The *MAIN MENU* is the primary access to the control computer for locomotive **service** and service-type operator related functions. The *MAIN MENU* is also the most interactive of the screen configurations - service personnel have multiple screen options available for evaluating performance, testing subsystems, and troubleshooting equipment and circuitry. Refer to Figure 4-8.

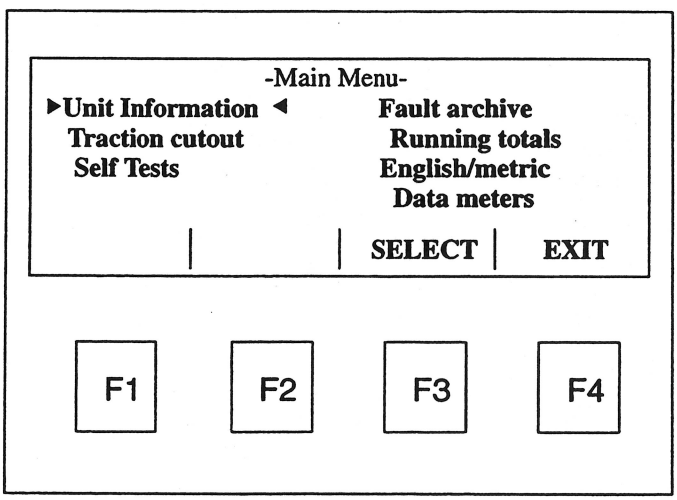


Figure 4-8. Main Menu Screen And Function Keys.

The cursor in Figure 4-8 is set to the **Unit Information** selection. If the SELECT function key F3 is pressed, then the display screen will change to the unit information screen shown in Figure 4-9, page 4-19.

UNIT INFORMATION

This selection on the ***MAIN MENU*** produces the ***UNIT INFORMATION*** screen shown in Figure 4-9 which is defined as follows -

uuuuuuuuu is the ***railroad initials and unit number*** and can be composed of numbers, letters, and/or spaces.

xxxxxxx is the EMD ***production number*** for the software code.

ttt is the ***traction motor cooling air temperature*** in ***°F.***

pp.pp: is the ***barometric pressure.***

dd mmm yy: is present ***day month year.***

hh:mm:ss: is ***hours:minutes:seconds*** in the 24 hour clock format.

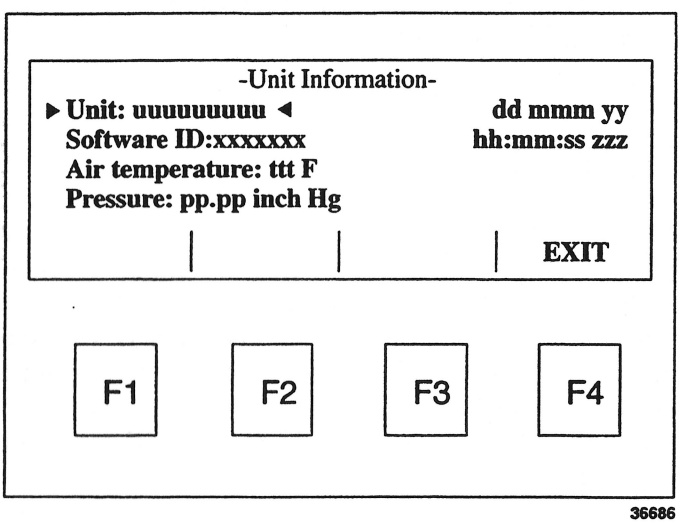


Figure 4-9. Unit Information Screen Format.

BLANK SCREEN

Screen blanking provides a means to eliminate the annoyance of the display screen when it is not needed. Screen blanking is actuated under the following conditions.

- Operating the **OFF** key on the keypad will automatically blank the screen.
- No keypad usage for 30 minutes automatically blanks the screen if -

  There are no active crew messages.

  AND

  A user is not running a self test or cutting out a device.

If an operator notices that the screen is blanked he can return to the previous screen by pressing the **ON** key within 10 minutes of the blanking.

OVERVIEW

For most locomotive operation, the display screen will be BLANK because no fault conditions exist and the locomotive operator has not used the keypad for 30 minutes. The intended usage or flow for display operation is with the screen blank due to the 30 minute timeout - interrupted by crew messages caused by fault or operating conditions that are reset or cut out on the ***CREW MESSAGE*** screen or through the ***MAIN MENU***.

SLOW SPEED OPERATION

See "SLOW SPEED CONTROL OPERATION" in OPERATION Section 3.

SERVICE NOTE

If a user is troubleshooting with the display, it would be inconvenient for a crew message to interrupt the screen in use. A feature is provided that allows the user to return to the screen he was on previous to the crew message interruption; he can turn off the crew message for 30 minutes and continue troubleshooting. The sequence occurs as follows:

- A crew message interrupts another screen.
- If the user presses the EXIT key within 10 minutes, then the crew message will be suppressed for 30 minutes and the screen that was previously displayed now reappears.
- If the EXIT key was not operated during the 10 minute time period, then the display retains the crew message screen.

CREW MESSAGE LIST

Due to the space limitations inherent with the Operating Manual format, it is impractical to present fully defined troubleshooting procedures for each Crew Message available with the Display Diagnostic System. Accordingly, the information presented in this section describes only the basics of the system; including the characteristics of the display keypad and screen, some of the particulars on the operations and manipulations available through the computer screen menus (supported by HELP screens) - and finally a listing of the more common potential crew messages. It should be noted, however, that some messages that appear in this list may not be available on this order of SD75I locomotives as they are associated with accessories and/ or special equipment that were not provided.

- ADA CHANNEL #n IS FAILED - REPLACE MODULE
- ADA #n MODULE IS MISSING
- AIR COMPRESSOR - LOW OIL PRESSURE
- AIR COMPRESSOR FAILURE - NOT OPERATING
- AIR COMPRESSOR FAILURE - SLOW SPEED OPERATION ONLY
- CHECK ENGINE - FAILED/OPEN ENGINE - IN FUEL PRESSURE SENSOR
- CHECK ENGINE - FAILED/OPEN ENGINE - OUT FUEL PRESSURE SENSOR
- CHECK ENGINE - FAILED/OPEN FUEL TEMPERATURE SENSOR
- CHECK ENGINE - FAILED/OPEN FUEL FILTER PRESSURE SENSOR
- CHECK ENGINE - FAILED/OPEN LUBE OIL FILTER PRESSURE SENSOR
- CHECK SPIN-ON FUEL FILTERS - HIGH FUEL PRESSURE INTO THE ENGINE
- CIRCUIT BREAKERS IN THE BLACK AREA ARE NOT ALL CLOSED
- DIO #n MODULE IS MISSING
- DYNAMIC BRAKE GRID OVERCURRENT
- DYNAMIC BRAKE MOTOR FIELD OVEREXCITATION
- ENGINE AIR FILTERS DIRTY
- ENGINE AIR FILTERS DIRTY - THROTTLE 6 LIMIT
- ENGINE DEAD - UNIT IN WINTER ISOLATE
- ENGINE DEAD - UNIT NOT ISOLATED
- ENGINE DIED WHILE ISOLATED
- ENGINE NOT RUNNING
- ENGINE PROTECTION SHUTDOWN
- ENGINE SHUTDOWN - ENGINE COOLANT PRESSURE
- ENGINE SHUTDOWN - ENGINE CRANKCASE PRESSURE
- ENGINE SHUTDOWN - ENGINE OIL PRESSURE
- ENGINE SHUTDOWN - ENGINE OIL TEMPERATURE
- ENGINE SPEED FAILURE
- ENGINE SPEED INCREASE - COOL DOWN CYCLE
- ENGINE SPEED INCREASE - LOW AIR PRESSURE
- ENGINE SPEED INCREASE - LOW WATER TEMPERATURE
- ENGINE SPEED INCREASE - MANUAL LOW IDLE OVERRIDE
- ENGINE SPEED INCREASE - TRACTION MOTOR COOLING
- ENGINE SPEED INCREASE - LOW AIR PRESSURE
- ENGINE SPEED INCREASE - WINTER ISOLATE

- EXCEEDED MOTOR SHORT-TIME RATING
- FILTER BLOWER MOTOR CIRCUIT BREAKER IS OPEN
- FORCED IDLE - ENGINE RUN SWITCH DOWN
- FORCED IDLE - TRACTION MOTOR BLOWER #n FAULT
- FORCED THROTTLE 3 LIMIT -
  AIR COMPRESSOR HIGH SPEED FAILURE
- FUEL PUMP NOT RUNNING
- GENERATOR FIELD OVEREXCITATION
- GOVERNOR SHUTDOWN
- GROUND RELAY - DYNAMIC BRAKE
- GROUND RELAY - POWER
- HOT ENGINE - LEAD UNIT NULLIFICATION
- HOT ENGINE - THROTTLE 6 LIMIT
- #n LOCKED POWER WHEEL
- #n LOCKED WHEEL
- #n LOCKED WHEEL DETECTION DISABLED
- #n LOCKED WHEEL PROTECTION ENABLED
- LOW HORSEPOWER INDICATION
- LUBE OIL FILTER BYPASSED
- MEM MODULE IS MISSING
- MOTOR IS CUTOUT DUE TO A FAULT
- MOTOR #n SLIPPED PINION
- NO ACTIVE CREW MESSAGES
- NO DYNAMIC BRAKE - DYNAMIC BRAKE CUTOUT
- NO DYNAMIC BRAKE - GROUND RELAY LOCKOUT
- NO DYNAMIC BRAKE - TRACTION MOTOR CUTOUT
- NO DYNAMIC BRAKE -
  TRACTION MOTOR #n FLASHOVER GROUND RELAY LOCKOUT
- NO LOAD - COMPUTER HARDWARE FAILURE
- NO LOAD - ENGINE TEMPERATURE FEEDBACK FAILURE
- NO LOAD - FORCED STOP
- NO LOAD - GENERATOR FIELD SWITCH DOWN
  OR SDR RELAY IS PICKED UP
- NO LOAD - GROUND RELAY CUTOUT
- NO LOAD - IMPROPER B CONTACTOR STATUS
- NO LOAD - IMPROPER B1 CONTACTOR STATUS
- NO LOAD - IMPROPER DC STATUS
- NO LOAD - IMPROPER GFC STATUS
- NO LOAD - IMPROPER GFD STATUS
- NO LOAD - IMPROPER LTT STATUS

- NO LOAD - IMPROPER P CONTACTOR STATUS
- NO LOAD - IMPROPER S CONTACTOR STATUS
- NO LOAD - IMPROPER SB CONTACTOR STATUS
- NO LOAD - IMPROPER SSCR STATUS
- NO LOAD - IMPROPER SGC STATUS
- NO LOAD - MB SWITCHGEAR NOT CORRECT
- NO LOAD - NEED AT LEAST 2 MOTORS CUT IN
- NO LOAD - NO COMPANION ALTERNATOR OUTPUT
- NO LOAD - PCS OPEN
- NO LOAD - RV SWITCHGEAR NOT CORRECT
- NO LOAD - SIMULTANEOUS FORWARD/ REVERSE REQUEST
- NO LOAD - SIMULTANEOUS POWER/SLOW SPEED REQUEST
- NO LOAD - THROTTLE NOT RESET
- NO LOAD - TM #n CUTOUT IN PROGRESS
- NO LOAD - TM #n FAILED TO CUTOUT
- NO LOAD - TM #n FAILED TO RECONNECT
- NO LOAD - UNIT IS ISOLATED
- NO LOAD TEST, DYNAMIC BRAKE - EXCESSIVE GRID BLOWER #n CURRENT
- NO LOAD TEST, DYNAMIC BRAKE - GRID BLOWER #n GRID FAILURE
- NO LOAD TEST, DYNAMIC BRAKE - GRID CURRENT IMBALANCE
- NO LOAD TEST, DYNAMIC BRAKE - GRID OPEN CIRCUIT
- NO LOAD TEST, DYNAMIC BRAKE - GRID OVERCURRENT
- NO LOAD TEST, DYNAMIC BRAKE - GRID SECTION SHORTED
- NO LOAD TEST, DYNAMIC BRAKE - NO GRID BLOWER #n CURRENT
- NO POWER - GROUND RELAY LOCKOUT
- NO POWER - TRACTION MOTOR #n FLASHOVER GROUND RELAY LOCKOUT
- NO START - CONTROL CIRCUIT BREAKER OR CONTROL/FUEL PUMP SWITCH DOWN
- NO START - EPC FAILED TO PICK UP
- REDUCED DYNAMIC BRAKE - ENGINE SPEED UP FAILURE
- REDUCED LOAD - EMDEC COMMUNICATION FAILURE
- REDUCED LOAD - THROTTLE 3 LIMIT, HIGH AIR/OIL TEMPERATURE
- REDUCED LOAD - THROTTLE 6 LIMIT, FAILED/OPEN OIL PRESSURE SENSOR

- REDUCED LOAD - THROTTLE 6 LIMIT,
  FAILED/OPEN OIL TEMPERATURE SENSOR
- REDUCED LOAD - THROTTLE 6 LIMIT,
  HIGH FUEL PRESSURE INTO THE ENGINE
- REDUCED LOAD - THROTTLE 6 LIMIT,
  HIGH FUEL TEMPERATURE INTO THE ENGINE
- REDUCED LOAD - THROTTLE 6 LIMIT,
  LOW FUEL PRESSURE INTO THE ENGINE
- REDUCED LOAD - THROTTLE 6 LIMIT,
  FAILED/OPEN WATER PRESSURE SENSOR
- REDUCED POWER - TRACTION MOTOR CUTOUT
- REDUCED POWER - TRACTION MOTOR #n OPEN
- REDUCED POWER, DYNAMIC BRAKE -
  TRACTION MOTOR BLOWER #n FAULT
- REDUCED TRACTIVE EFFORT - TRACTION MOTOR OVERLOAD
- REVERSER HANDLE CENTERED
- SIMULTANEOUS POWER/DYNAMIC BRAKE REQUEST
- STARTER MOTOR OVERLOAD
- TRACTION MOTOR BLOWER #n SLOW SPEED FAULT -
  FAN WILL REMAIN IN HIGH SPEED
- TRACTION MOTOR #n CUTOUT
- TRACTION MOTOR #n FLASHOVER
- TRAINLINE ALARM BELL
- TURBOCHARGER CIRCUIT BREAKER OPEN
- TURBOCHARGER LUBE PUMP NOT RUNNING
- UNIT IN SLOW SPEED
- VOLTAGE LIMITING DUE TO GROUND RELAY
- WATER DRAIN DISABLED OR CIRCUIT BREAKER OPEN
- WHEEL OVERSPEED

INDICATOR LIGHT MESSAGES

The Operator's Overhead Console incorporates four (4) indicator lights. Each indicator is imprinted with a word or phrase that conveys a message for the locomotive operator.

WHEEL SLIP Light, Continuous or Flashing Regularly

Conditions: Locked powered wheel. It takes ten (10) seconds for the locomotive computer to detect this fault. Then, for the next five (5) seconds, the **WHEEL SLIP** indicator light will be **ON** continuously, traction power will be cut off and the computer will display the **#N LOCKED POWER WHEEL** message. Computer then allows traction power to return, and turns off the indicator light and the displayed message. If throttle is not returned to **IDLE**, the cycle will repeat. Note that the **WHEEL SLIP** light is trainlined.

Action Required: Move throttle handle to **IDLE**. FOLLOW PROCEDURES PROVIDED FOR "LOCKED POWERED WHEEL" in OPERATION Section 3.

WHEEL SLIP Light, Continuous or Flashing Regularly - continued

Conditions: If the locomotive computer senses this fault (traction motor spinning too freely), it causes the **WHEEL SLIP** indicator light to flash (cycle) **ON** and **OFF** (3 seconds on / 3 seconds off). In addition, the computer will display the **POSSIBLE SLIPPED PINION DETECTED/ VOLTAGE LIMITING IN ORDER TO VERIFY** message. The **WHL SLIP** light on and off cycle and the computer message display will continue while the computer tests the suspect traction motor circuit to verify the fault (Low-level power is applied to the traction motors during this test, which requires up to four [4] minutes).

If the computer ***does not*** verify the slipped pinion fault; it cancels the fault and the computer message display, turns off the **WHEEL SLIP** indicator light, and re-enables normal locomotive operation.

If the computer ***does*** verify the slipped pinion fault; it drops out power and dynamic brake operation until the fault is reset, latches in the fault condition, it displays the **MOTOR #N SLIPPED PINION LOCKOUT** message, and it continues to cycle the **WHEEL SLIP** indicator light. The fault must be cleared before the computer will stop cycling the **WHEEL SLIP** indicator light.

Action Required: Move throttle handle to **IDLE.** **FOLLOW PROCEDURES PROVIDED FOR "LOCKED POWERED WHEEL" and "SLIPPED PINION" in Section 3.**

WHEEL SLIP Light, Flashing Irregularly or Occasionally

"A" Conditions: Speed **under 1.5 MPH;** normal startup wheelslip correction operation.

Action Required for "A" Conditions: No action required. Do not reduce throttle unless slipping threatens to break the train.

"B" Conditions: Speed **over 1.5 MPH;** backup of Super Series wheel creep control operation. Possible failure of Super Series. May also indicate normal wheelslip detection/ control on trainlined non-Super Series units.

Action Required for "B" Conditions: No action required. Do not reduce throttle unless slipping threatens to break the train.

"C" Conditions: Wheel slide in dynamic braking.

Action Required for "C" Conditions: None.

"D" Conditions: Wheel overspeed detected by computer. The indicator light will flash **ON** and **OFF** (3 seconds on & 3 seconds off) to indicate wheel (and traction motor) overspeed, and the computer will display the **WHEEL OVERSPEED** message. This can be caused by excessive track speed or by simultaneous slipping of all wheels. In either case, the system automatically corrects by regulating main generator output power (power drops out until speed drops, then picks up again). The computer message and indicator light flashing are automatically cancelled after recovery.

Action Required for "D" Conditions: Reduce throttle setting.

PCS OPEN Light On

Conditions: Penalty or emergency brake application and loss of power. Computer displays the **NO LOAD - PCS OPEN** message, motoring/ dynamic braking power is cut off, and diesel engine is limited to throttle 1 speed.

Action Required: Move throttle to **IDLE**. Move automatic brake valve to **EM (Emergency)** and wait 45 seconds, then move to **REL (Release)** position. Reset Train Monitoring system using operator's push-button signal switch or foot switch.

SLOW SPEED Light On

"A" Conditions: Light comes **ON** when Slow Speed Control System is operating in **CONTROL** mode. Refer to SLOW SPEED CONTROL OPERATION in OPERATION Section 3 for more information.

Action Required: None.

BRAKE WARN (Warning) Light On

Conditions: Excessive dynamic brake current.

Action Required: Reduce dynamic brake handle position immediately. If light stays **ON**, move **DYN BRAKE** cutout switch on the Engine Control Panel to the **OFF** position. Computer will then display the **NO DYNAMIC BRAKE - DYNAMIC BRAKE IS CUT OUT** message.

EMDEC SYSTEM

INTRODUCTION

The majority of the troubleshooting information available to the operating crew will continue to be provided in the locomotive cab by means of the EM2000 Computer Display and the Indicating Lights located on the Operator's Overhead Console.

Perform all troubleshooting action steps previously referenced in this section for the computer displayed crew messages and indicator lights with consideration for any references relating to engine control functions which are performed by the EMDEC system. For convenience, several of the most common computer displayed crew messages which correspond to fault lights of the EMDEC system are described first followed by a description of the additional diagnostic features provided by the EMDEC system.

COMPUTER DISPLAY MESSAGES / EMDEC FAULT LIGHTS

ENGINE PROTECTION SHUTDOWN

Conditions: Engine stopped. Conditions causing shutdown with related *lower priority* crew message and corresponding EMDEC fault indication are as follows:

- ENGINE SHUTDOWN - ENGINE COOLANT PRESSURE (annunciator panel "Low Water Pressure" fault light **ON**); or
- ENGINE SHUTDOWN - ENGINE CRANKCASE PRESSURE (annunciator panel "Crankcase Pressure" fault light **ON**, ***crankcase pressure button out***); or
- ENGINE SHUTDOWN - ENGINE OIL PRESSURE (annunciator panel "Low Oil Pressure" fault light **ON**); or
- ENGINE SHUTDOWN - ENGINE OIL TEMPERAURE (annunciator panel "Hot Oil Temp" fault light **ON**).

Action Required: Check button on crankcase pressure detector.

WARNING

If crankcase pressure detector has tripped, STOP engineroom inspection. Do **NOT** attempt to restart engine. Isolate the unit. Drain cooling system in accordance with railroad regulations if freezing conditions are possible. If crankcase pressure detector has not tripped, and engine oil level is satisfactory, but hot engine condition is apparent, do **NOT** attempt to restart engine until it has cooled down.

To enable engine restart after fault condition is corrected, reset crankcase detector button (if tripped). Reset the fault at the EM2000 computer display. At the annunciator (fault) panel, place the **FUEL INJECTION** switch in the ***STOP*** position, and then return it to the ***RUN*** position in order to clear the fault indication. Check to be certain fault light that indicated cause of shutdown is reset (**OFF**) and that the system ready light is **ON.**

LOW HORSEPOWER INDICATION

Conditions: Engine unable to provide normal throttle 8 speed traction power (load regulating function of the EMDEC system reduced load) for at least 20 minutes.

Action Required: If message persists, notify maintenance personnel.

Note: Additional *lower priority* crew messages are provided by the EM2000 computer display; including those under the **CHECK ENGINE -** and/or **REDUCED LOAD - THROTTLE 3 (OR 6) LIMIT,** categories, which will relate to a condition at a specific pressure or temperature sensor in an EMDEC engine protection or diagnostic circuit. ***If any of these messages persist, notify maintenance personnel.***

SPECIAL NOTICE

Any fault condition that could cause the EMDEC system to shut down the engine can also occur due to a break (open) in the connections or wiring between an engine protection sensor and the system's *master* Electronic Control Module (ECM). Therefore, it is important to exercise special care in order to prevent damage to the EMDEC system harness wires and connectors.

EMDEC SYSTEM DIAGNOSTICS

After performing all normal troubleshooting action steps, it may be necessary to conduct a further diagnosis of possible EMDEC related problems.

Troubleshooting the EMDEC system is intended to be done using a PC computer with a special diagnostics program. In most instances, only the computer program can provide the information necessary for a complete diagnosis of the problem. However, use of the PC computer requires qualified maintenance personnel along with a variety of special tools and equipment which are normally only available at railroad maintenance facilities. Therefore, it may be found more expedient to do a read out of the EMDEC "flash code(s)" first in order to evaluate the extent of the problem.

READING DIAGNOSTIC CODES - FLASH METHOD

The following are the basic procedural steps that can be used for reading the diagnostic "flash code(s)" of the EMDEC system.

NOTE:

These procedures require two individuals to perform; one person must be positioned in the locomotive cab to actuate the ENGINE CONTROL circuit breaker while the other observes the LED indicator lights on the annunciator (fault) panel in the engineroom and actuates the FAULT LIGHTS (diagnostic request) switch.

1. Cycle **ENGINE CONTROL** circuit breaker **OFF** (down), then back **ON** (up) and observe "yellow" check engine light (CEL) on the annunciator (fault) panel.

   a. If light comes on and stays on; proceed to step 2.

   b. If light is flashing; refer to maintenance personnel to check for an Intermittent condition.

c. If light remains off; hold **FAULT LIGHTS** switch in the ***TEST*** position to check LED indicator lights. If light will then come on, refer condition to maintenance personnel to check for possible opens or grounds in system wires and connectors.

2. Read out "Diagnostic Code(s)" by placing **FAULT LIGHTS** switch in the ***CODE*** position.

   a. If light is flashing out code(s); proceed to step 3.

   b. If light remains on, but does not flash out any code(s); repeat step 1 to check operation of "red" stop engine light (SEL)

3. Note and record flash code(s).

   a. Light is flashing out code 25; (two blinks, a 1/2 second pause, followed by five blinks) indicates there are No Codes set - system is functioning normally.

   b. Light is flashing out code(s) beginning with 52, possible followed by other code(s); indicates an ECM failure (see code listing to identify other code[s] which should be serviced first).

   c. Light is flashing out code(s) NOT beginning with code 52; proceed to step 4.

   d. No codes flashing; if problem persists, system must be checked for an Intermittent or No Code condition.

4. Re-cycle **ENGINE CONTROL** circuit breaker **OFF** (down), then back **ON** (up) and observe "yellow" check engine light (CEL) to verify flash code(s).

   a. If CEL light comes on and stays on, read out code(s) and identify from code listing.

   b. If light does not come on; proceed to step 5.

c. If light is erratic or intermittent; refer condition to maintenance personnel.

5. Attempt to start and run the engine in order to verify flash code(s). If engine starts, allow it to warm up, then try to get the CEL light to come on and stay on for at least one minute by slowly changing engine speeds.

   a. If engine will not start, perform all normal mechanical checks including the locomotive battery and fuel system first, then ensure that **FUEL INJECTION** switch is in the **RUN** (up) position and **SYSTEM READY** light is on. Also, check for any CEL light code(s); read out code(s) and identify from code listing. If light is not on, check to be certain **ENGINE CONTROL** circuit breaker is **ON** (up). If problem still is not found, refer condition to maintenance personnel to check for possible opens or grounds in system wires and connectors.

   b. If CEL light is off, any previous code(s) should be considered as Intermittent; refer condition to maintenance personnel.

   c. If light is on; read out code(s) and identify from code listing.

NOTE:

The following code listing is presented for reference only.

EMDEC DIAGNOSTIC CODES

FLASH CODE 14 (SAE 175/3)

- Oil Temperature Sensor (OTS) input voltage to the ECM is high.

FLASH CODE 15 (SAE 175/4)

- Oil Temperature Sensor (OTS) input voltage to the ECM is low.

FLASH CODE 23 (SAE 174/3)

- Fuel Temperature Sensor (FTS) input voltage to the ECM is high.

FLASH CODE 24 (SAE 174/4)

- Fuel Temperature Sensor (FTS) input voltage to the ECM is low.

FLASH CODE 25 (SAE N/A)

- No codes are set.

FLASH CODE 32 (SAE 238/4)

- Stop Engine Light (SEL) circuit is open or shorted to ground.

FLASH CODE 32 (SAE 239/3)

- Check Engine Light (CEL) circuit is shorted to battery (+) and the ECM is unable to turn on the Stop Engine Light (SEL).

FLASH CODE 32 (SAE 239/4)

- Check Engine Light (CEL) circuit is open or shorted to ground.

FLASH CODE 33 (SAE 102/3)

- Turbo Boost Sensor (TBS) input voltage to the ECM is high.

FLASH CODE 34 (SAE 102/4)

- Turbo Boost Sensor (TBS) input voltage to the ECM is low.

FLASH CODE 35 (SAE 100/3)

- Oil Pressure Sensor (OPS) input voltage to the ECM is high.

FLASH CODE 36 (SAE 100/4)

- Oil Pressure Sensor (OPS) input voltage to the ECM is low.

FLASH CODE 37 (SAE 94/3)

- Fuel Pressure Sensor (FPS) input voltage to the ECM is high.

FLASH CODE 38 (SAE 94/4)

- Fuel Pressure Sensor (FPS) input voltage to the ECM is low.

FLASH CODE 41 (SAE 21/0)

- Synchronous Reference Sensor (SRS) has detected extra pulses, or Timing Reference Sensor (TRS) has detected missing pulses.

FLASH CODE 42 (SAE 21/1)

- Synchronous Reference Sensor (SRS) has detected missing pulses, or Timing Reference Sensor (TRS) has detected extra pulses.

FLASH CODE 44 (SAE 175/0)

- Oil Temperature Sensor (OTS) has detected high engine oil temperature (above safe operating range).

FLASH CODE 45 (SAE 100/1)

- Oil Pressure Sensor (OPS) has detected low engine oil pressure (below safe operating range).

FLASH CODE 46 (SAE 168/1)

- ECM has detected low locomotive battery supply voltage (below required operating range).

FLASH CODE 47 (SAE 94/0)

- Fuel Pressure Sensor (FPS) has detected high fuel supply pressure (above safe operating range).

FLASH CODE 52 (SAE 254/12)

- ECM internal Analog to Digital (A/D) Convertor has malfunctioned. Note: This is an Intermittent condition usually caused by faulty external electrical system.

FLASH CODE 53 (SAE 253/2 or 12)

- ECM unable to read (2) or update (12) an engine data record (calibration, faults, or accumulators) stored in nonvolatile memory.

FLASH CODE 55 (SAE 248/8 or 9)

- Master ECM has stopped receiving status information from one (or both) Receiver ECM(s).
  OR
  Receiver ECM has stopped receiving fueling information from Master ECM.

FLASH CODE 56 (SAE 250/12)

- ECM unable to transmit over data link circuit due to an open or short in the system wiring.

FLASH CODE 61 (SAE xxx/0)

- Time from ECM request to turn on injector to when injector solenoid valve closes exceeds high limit of expected range. Injector Subsystem IDentifier (SID) will indicate which cylinder has injector with long response time. Wide variations in response time at steady RPM usually indicate electrical problem. Consistently long response times may indicate sticking solenoid valve.

FLASH CODE 67 (SAE 109/3 or 4)

- Coolant Pressure Sensor (CPS) input voltage to the ECM is high.
  OR
  Coolant Pressure Sensor (CPS) input voltage to the ECM is low.

FLASH CODE 71 (SAE xxx/1)

- Time from ECM request to turn on injector to when injector solenoid valve closes is less than lower limit of expected range. Injector Subsystem IDentifier (SID) will indicate which cylinder has injector with short response time. Wide variations in response time at steady RPM usually indicate electrical problem. Consistently short response times may indicate failed solenoid valve.

FLASH CODE 75 (SAE 168/0)

- ECM has detected high locomotive battery supply voltage (exceeds required operating range).

FLASH CODE 81 (SAE 101/3)

- Crankcase Pressure Detector input voltage to the ECM is high.

FLASH CODE 82 (SAE 101/4)

- Crankcase Pressure Detector input voltage to the ECM is low.

FLASH CODE 83 (SAE 101/0)

- Crankcase Pressure Detector has detected high engine crankcase pressure (above safe operating range).

FLASH CODE 84 (SAE 101/1)

- Crankcase Pressure Detector has detected low engine crankcase pressure (below safe operating range).

FLASH CODE 88 (SAE 109/1)

- Coolant Pressure Sensor (CPS) has detected low engine coolant pressure (below safe operating range).

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